DEPARTMENT OF WATER RESOURCES
U.S. ARMY CORPS OF ENGINEERS

D R A F T

DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE CONCEPTS EVALUATION

PREPARED FOR:

ENTRIX, INC.
SACRAMENTO, CA

PREPARED BY:

WOOD RODGERS, INC.
SACRAMENTO, CA

SEPTEMBER 2003

TABLE OF CONTENTS

PAGE

LIST OF TABLES

No.

LIST OF FIGURES

No.

APPENDICES

I. SUMMARY OF FINDINGS

The alternative concepts presented in this report represent a short-listed summary of an extensive list of concepts derived and considered by the Yuba River Technical Working Group (Working Group) to meet the established goal and objectives for the Daguerre Point Dam Fish Passage Improvement Project (Project). The primary goal and objectives for the Project, as set forth in the Planning and Coordination Report, dated February 25, 2002, are as follows:

> <u>*Goal*</u>
>
> *To improve upstream and downstream fish passage for native anadromous fish species at Daguerre Point Dam and contribute to overall population recovery.*
>
> <u>*Objectives*</u>
>
> 1. *Keep water interests whole.*
> 2. *No increase in flood risk.*

The purpose of this evaluation is to describe the respective alternative concepts and examine the benefits and limitations of each. Additionally, this evaluation provides order of magnitude costs for each alternative to compare the impacts to fish passage, water supply interests, and downstream flood protection relative to the cost to implement the selected alternative. The information presented in this report is to assist the Working Group in developing a better understanding of each alternative concept and the potential of each to attain the project goal and objectives.

A summary is presented on Table 1, including a description of the alternative concept, the benefits, limitations, and cost for each.

With respect to the project goal, the effectiveness and reliability for fish passage come at a price. The greater the benefits for fish passage does not necessarily equate to the best or most cost-effective concept. The preferred alternative concept would need to be determined as a result of discussion and compromise among the stakeholders. The most practical and reasonable solution should best satisfy the program goal and objectives within a reasonable design and construction budget and within an acceptable level of impacts to the environment and the parties dependent upon the resources.

Table 1. Summary of Alternative Concepts

Concept Alternative	Benefits	Limitations	Estimated Costs[1] (Millions of $) Construction	O&M
1. No-Action	No Cost/No Disturbance at Site	No Improvement to Fisheries	$ 0.0	$ 0.0
2A. Replace Existing Fish Ladders with New Fishway Systems at Present Locations	Some Improvement to Upstream Fish Passage Maintains Dam and Upstream Sediment Maintains Upstream Gravity Diversion Capabilities Maintains Downstream Channel Conveyance	No Improvement to Downstream Fish Passage Potential for Fall-Back and Injury of In-Migrants Without the Inclusion of Spillway Gates Continued Potential for Predation and Operation and Maintenance Demands	$ 5.5	$ 0.2
2B1. Construct New Fishway Systems at Strategic Locations Within Existing Dam	Significant Improvement to Upstream Fish Passage/Maintains Presence of Dam and Upstream Sediment/Maintains Upstream Gravity Diversion Capabilities/Maintains Downstream Channel Conveyance	Little Improvement to Downstream Fish Passage/Continued Potential for Fall-Back and Injury of In-Migrants Without the Inclusion of Spillway Gates/Unproven Design Concept/ Continued Potential for Predation and Operation and Maintenance Demands/Access Difficulty and Hazardous	$ 5.0	$ 0.25
2B2. Construct Series of Low-Head Weirs Downstream of Existing Dam	Significant Improvement to Upstream and Downstream Fish Passage/Maintains Presence of Dam and Upstream Sediment/Maintains Upstream Gravity Diversion Capabilities/Maintains Downstream Channel Conveyance/Minimal Operation and Maintenance	Some Disturbance of River Channel/Unknown Flood Flow Resilience and System Integrity/Subject to Changes in River Geomorphology/Some Increase in Water Level Upstream of Dam	$ 17.5	$ 0.05
3. Notch Dam to a Passable Height	Improvement to Fish Passage of all Life Stages Through Removal of Obstacle/New Regulatory-Compliant, Fish Screened Diversions	Disturbance to Upstream River Channel and Sediment/Requires Sediment Disposal Area for 2 Million Cubic Yards\Requires New Diversion Facilities/Requires Multiple Construction Seasons/High Operating Costs/Higher Maintenance Requirements/Eliminates Existing Wetlands and Riparian Habitat	$ 63.0	$ 2.0
4A. Construct a Steep Engineered Channel Around East End of Existing Dam	Minor Improvement to Upstream Fish Passage/ Maintains Presence of Dam and Upstream Sediment/ Maintains Upstream Gravity Diversion Capabilities/ Maintains Downstream Channel Conveyance/Easily Accessible for Operation & Maintenance	Little Improvement to Downstream Fish Passage/Low Potential for Discovery Given Poor Siting Location/Continued Potential for Fall-Back and Injury of In-Migrants/Continued Potential for Predation	$ 2.5	$ 0.10
4B. Construct a Mild Slope, Engineered Channel Around East End of Existing Dam	Minor Improvement to Upstream Fish Passage/ Maintains Presence of Dam and Upstream Sediment/ Maintains Upstream Gravity Diversion Capabilities/ Maintains Downstream Channel Conveyance/Easily Accessible for Operation & Maintenance	Little Improvement to Downstream Fish Passage/Low Potential for Discovery Given Poor Siting Location/Continued Potential for Injury of In-Migrants/Continued Potential for Predation	$ 7.5	$ 0.20

5A. Remove Dam and Construct New Fish Screens and Pump Stations in Vicinity of Present Diversions	Improvement to Fish Passage of all Life Stages through Removal of Obstacle/New Regulatory-Compliant, Fish Screened Diversions	Disturbance to Upstream River Channel and Sediment/Requires Sediment Disposal Area for 4 Million Cubic Yards\Requires New Diversion Facilities/Requires Multiple Construction Seasons/High Operating Costs/Higher Maintenance Requirements/Eliminates Existing Wetlands and Riparian Habitat	$ 76.0	$ 2.0
5B. Remove Dam and Construct New Fish Screens and Diversion Structures Three Miles Upstream of Existing Dam	Improvement to Fish Passage of all Life Stages Through Removal of Obstacle/New Regulatory-Compliant, Fish Screened Diversions	Requires Sediment Disposal Area for 4 Million Cubic Yards\Disturbance to Upstream River Channel and Sediment/Requires New Diversion Facilities/Requires Multiple Construction Seasons/Eliminates Existing Wetlands and Riparian Habitat	$ 97.0	$ 0.50

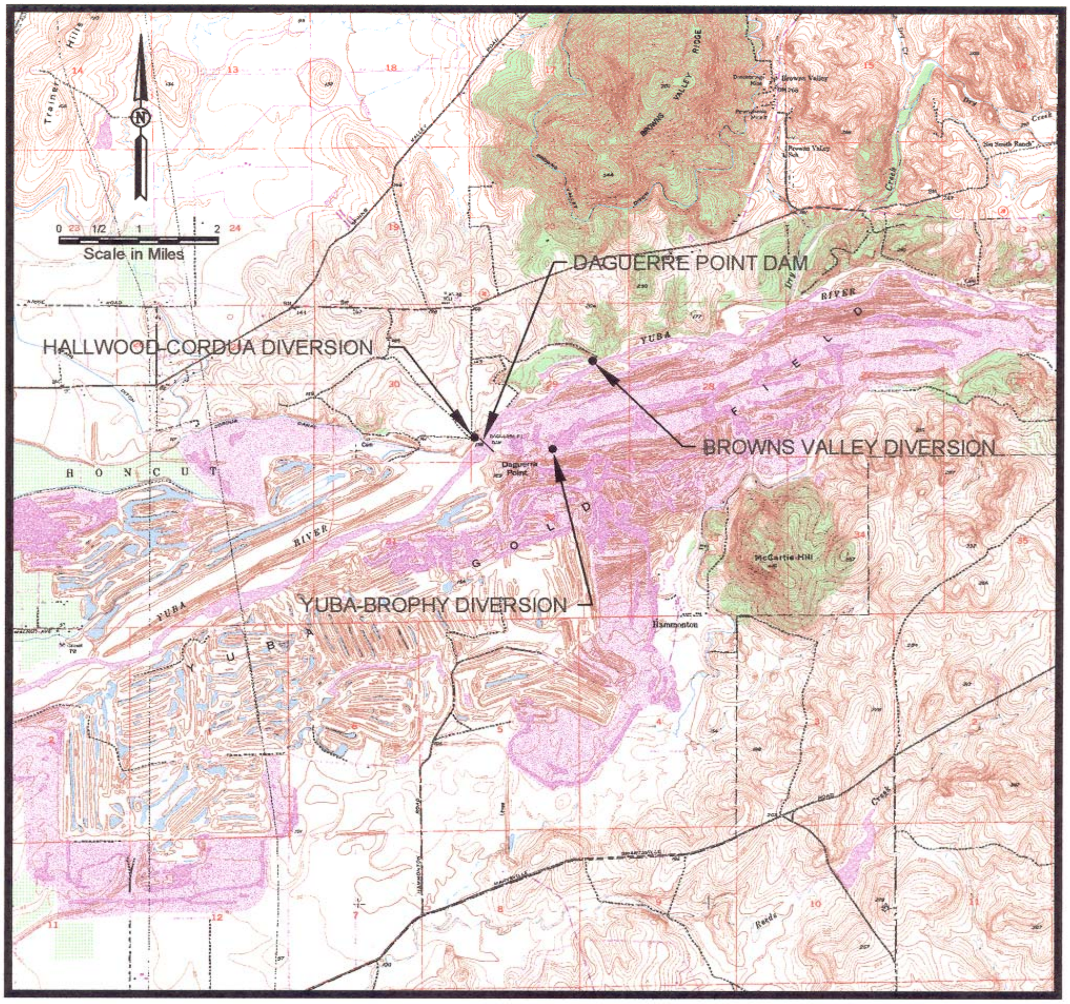
[1]Order of magnitude costs do not reflect environmental compliance and permitting activities.

I. INTRODUCTION

The California Debris Commission constructed the Daguerre Point Dam in the early 1900's as a component of the Yuba River Debris Control Project to entrap tailings from hydraulic gold mining operations. Its primary objective was to retain and control sediments discharged into the Yuba River from mining operations. As development intensified within the Yuba Valley in the early 1950's, the Yuba River and Daguerre Point Dam took on a new purpose. The people of Yuba and Sutter counties recognized the demand for securing, utilizing, and distributing the Valley's available water resources consistent with the impending domestic and agricultural development. The function of the dam has subsequently evolved to provide additional benefits from the standpoint of water supply. The Daguerre Point Dam and associated facilities are the shared operational responsibility of the U.S. Army Corps of Engineers (USACOE), Construction Operations Division and the California Department of Water Resources (DWR).

The dam currently creates the head or stage in the river that enables gravity and pumped diversions for six primary diverters: the Hallwood Irrigation Company, the Cordua Irrigation District, the Ramirez Water District, the Browns Valley Irrigation District, the Brophy Water District, and the South Yuba Water District. Three separate diversion facilities have been constructed, as presented on Figure 1, to accomplish surface water diversion upstream of the dam. These points of diversion are entirely dependent upon the stage conditions created by Daguerre Point Dam, which enable the diverters to appropriate water from the Yuba River up to a maximum combined diversion rate of 1,350 cubic feet per second.

The Daguerre Point Dam consists of a reinforced concrete, ogee-shaped weir and apron approximately 575 feet long and 24 feet high on average. The dam was authorized for construction by the Rivers and Harbors Act of 1902, and was completed in 1910. Since its original inception in the late 1800's as part of the overall Yuba River Debris Control Project, the Daguerre Point Dam has been fully reconstructed in response to flood-related damages in



VICINITY MAP

IN: YUBA RIVER AT: RIVER MILE 11.4 COUNTY OF: YUBA STATE: CA	DAGUERRE POINT DAM AND AFFILIATED DIVERSIONS DEPARTMENT OF WATER RESOURCES FISH PASSAGE IMPROVEMENT PROJECT DEPARTMENT OF WATER RESOURCES 1416 NINTH STREET SACRAMENTO, CA 95814	WOOD RODGERS ENGINEERING • MAPPING • PLANNING • SURVEYING 3301 C St, Bldg. 100—B Tel 916.341.7760 Sacramento, CA 95816 Fax 916.341.7767 FIGURE 1 DATE: 10-31-02

1963 and 1964. Crude fish ladders were constructed at each end of the dam in 1911. The fish ladders were destroyed in 1927-28 and reconstructed in 1938. Again the ladders were destroyed in 1950 and reconstructed in 1965. The existing fish ladders are operated in accordance with an established operating protocol, during spawning periods, as directed by the California Department of Fish and Game (CDFG). According to fisheries biologists, the ability of the pool-and-weir fish ladders to assist anadromous fish passage upstream of the dam has been ineffective.[20]

In 1994, the Yuba River Technical Working Group (YRTWG) and the U.S. Fish and Wildlife Service (USFWS) identified fish passage problems at Daguerre Point Dam. As a result, a preliminary evaluation of measures and alternative concepts to improve fish passage was conducted by the USACOE. Subsequently, the Daguerre Point Dam Fish Passage Improvement Project was initiated with DWR and the USACOE as lead agencies. A separate committee was formed, identified as the Daguerre Point Dam Fish Passage Working Group (Working Group), and the primary goal and objectives for the project were established as follows:

> <u>*Goal*</u>
>
> *To improve upstream and downstream fish passage for native anadromous fish species at Daguerre Point Dam and contribute to overall population recovery.*
>
> <u>*Objectives*</u>
>
> 1. *Keep water interests whole.*
> 2. *No increase in flood risk.*

Measures aimed at attaining the goal and objectives of the project can have wide-ranging impacts. Accordingly, several federal, state, and local agencies; public organizations; independent consultants; and private parties comprise the Working Group.
The Working Group was created to address individual stakeholder interests and/or concerns relative to the proposed action to reconcile fish passage issues at the dam. The Working Group

is responsible for collectively determining potential modifications at Daguerre Point Dam consistent with the project goal and objectives. DWR and USACOE, jointly, are the responsible lead agencies for the CEQA/NEPA processes, overall project management, and are charged with the responsibility of ensuring the project goal and objectives are achieved.

Through the process of collaboration within the Working Group, the regulatory agencies and stakeholders collectively identified a variety of alternative concepts for resolving fish passage concerns. An exhaustive list of concepts was formulated, considered, and consolidated into a summary of alternative concepts, which appeared to best address the options available at the Daguerre Point Dam for the purpose of enhancing fish passage, maintaining surface water diversion capabilities, minimizing sediment transport, mitigating adverse environmental impacts, and offering practical, cost-effective solutions.

The alternative concepts addressed in this evaluation represent the summary of ideas and concepts to improve both upstream and downstream passage of anadromous fish as agreed upon by the Working Group. The feasibility of the respective alternative concepts is assessed with consideration given to fisheries benefits and limitations, environmental impacts, sediment/mercury containment, water supply impacts, operation and maintenance requirements, engineering and construction demands, and economics. The overall purpose of this evaluation is to describe and quantify each alternative concept in sufficient detail to assist the Working Group in selecting alternative concept(s) to consider in the environmental review process.

The alternative concepts presented herein are developed at a conceptual level only. Minor variations may be available within the scope of each alternative concept to address specific undesirable conditions, yet would likely only mitigate issues for a limited range of service conditions or performance periods. Input from the stakeholders may modify the concept alternatives to a final form to be analyzed in the environmental document. General engineering principles, hydraulic and water resource design techniques, and fish passage expertise were incorporated into the evaluation of each alternative concept to fulfill the project goal and objectives.

Concepts that merit little consideration, due to the non-solution oriented nature, are discussed briefly. An explanation for dismissal is provided for the respective concept. Concepts deemed to have merit are evaluated and discussed further. Based upon the experience of Wood Rodgers' staff, only those concepts that best fulfill the project goal and objectives are recommended for further consideration by the Working Group and lead agencies.

The next step following the completion of this report is to have the lead agencies and Working Group meet to discuss the concept descriptions and engineering details presented herein. These alternative concepts along with any refinement(s) would be carried forward for consideration in the environmental review process. Through the environmental review process, a preferred alternative would be identified that would best meet the project goal and objectives with the least environmental effects/impacts.

II. PROJECT LOCATION AND BACKGROUND

The Daguerre Point Dam is located in Yuba County, California, approximately eleven miles northeast of the City of Marysville, within the SW ¼ of Section 29, Township 16 N, Range 5 E, MDB&M. The facility is on the Yuba River approximately 11.4 miles upstream of the confluence with the Feather River. The dam and associated diversion facilities are positioned in the proximity of the remnant Yuba River Gold Fields (Figure 1). The areas surrounding the project site consist of rural undeveloped land, grazing land, great valley riparian forest, and low-density residential development.

Since the subject site was identified as a threat to the viable migration of chinook salmon and steelhead on the Yuba River, the USACOE, funded by USFWS funds from the Anadromous Fish Restoration Program (AFRP), conducted a preliminary evaluation of measures and alternative concepts to improve fish passage while addressing the need for continued diversion of surface water upstream of Daguerre Point Dam. Subsequently, the USACOE and DWR agreed to act as co-lead agencies and created a Project Management Team to further develop and evaluate potential alternative concepts. The Project Management Team has the responsibility of determining a preferred design alternative concept where the chances of success in meeting the goal and objectives are high, and satisfies stakeholder and agency-defined design objectives and interests.

The existing fish ladders at Daguerre Point Dam have been deemed ineffective for fish passage for all life stages. Due to the relatively small flow through the ladders compared to the flow over the dam, upstream migrating salmonids are not readily attracted to the fishway entrances and are subject to delay and injury. Without properly functioning fish ladders, the 20-foot-high dam is completely impassable to upstream migrants and is an endangerment to downstream migrant survival. The existing ladders offer limited potential of safe passage for downstream migrants due to a relatively small window of opportunity for discovery and access to the ladder exits. On the other hand, the opportunity for downstream passage over the dam is high, and subjects fish to abrasion, scale loss, and disorientation. Fish subjected to these factors are prone to higher rates of mortality and predation.

The existing fish ladders have a very low hydraulic capacity of 6 cfs per ladder according to the USACOE's "Preliminary Fish Passage Improvement Study," dated August 2001. However, according to USACOE operators of the fish ladders, the capacity is closer to 15 cfs to 25 cfs per ladder, depending upon the forebay water surface elevation. Nevertheless, flow in the Yuba River significantly exceeds the fish ladder capacities, hydraulically mask the fish ladder entrances, and render the ladders ineffective for the greater part of all migration periods.

Historically, the existing fish ladders have been removed from service approximately six months out of the year for reasons related to sedimentation, debris blockage, and the inability for timely access and responsive removal. These operating conditions continued until the last several years until a new operating protocol was implemented by the USACOE, in conjunction with CDFG, to operate the ladders year-round. According to USACOE operators, the existing fish ladders are now rarely affected by sedimentation, except during high flow events at which point the fish ladders are shut down and heavy equipment is used to restore exit conditions. The debris load is reportedly the most significant factor inhibiting operational reliability (according to USACOE Operations and Maintenance staff).

III. FISH PASSAGE DESIGN FLOW

One of the most important tasks in designing a fishway is estimating the design flow. Design flow through fishways is estimated in relation to the target fish migration period. Since the windows of upstream fish passage for fall-run and spring-run chinook salmon and steelhead in the Yuba River are overlapping, the facilities evaluated herein are configured to function throughout the year, to the maximum extent possible. The ability to characterize the opportunity for fish passage at a site is typically tied to understanding hydrologic characteristics of a particular river or stream.

For the purpose of this report, fish passage design flow is related to upstream fish passage, as minimum bypass flows required for downstream passage or residency is outside an engineering scope and is generally left to the fishery agencies to determine (CDFG Code 5937). Fish passage design flow is typically defined as the greatest flow in the river or stream at which fish passage must be provided. Delay in fish passage due to flow in excess of the selected design flow must be infrequent and short-lived to not be harmful. According to the report entitled, "Fishway Design Guidelines for Pacific Salmon," by Ken M. Bates, "*A variety of design flow criteria have been suggested or used. Gebhards and Fisher (1972) suggested an allowable migration delay of 6 consecutive days for salmon and trout. Dryden and Stein (1975) recommend that a 7-day impassable period should not be exceeded more than once in the design period of 50 years, and that a 3-day impassable period should not be exceeded during the average annual flood. The States of California and Washington suggest that passage should be provided 90% of the migration period of the target species (Kay and Lewis, 1970; Bates, 1988).*[3]

Standards set forth in the reference "Introduction to Fishway Design," authored by C. Katapodis were applied in the USACOE preliminary study. The reference states, *"A delay period of less than three (consecutive) days in annual spawning migrations is usually accepted for several freshwater species. Delays longer than three (consecutive) days may be acceptable with a 1:10 year frequency. These two criteria are used whenever sufficient data exist to estimate the maximum flow that is likely to prevail at the time of fish migration."* As a result, the USACOE determined from river gage data (USGS #11421000; 1942-1997) that 22,000 cubic feet per second (cfs) is a reasonable threshold. The NOAA-Fisheries (NOAA) and CDFG generally accept a fishway design flow of 10% of the determined fish passage design flow. Applying this criteria, the fishway design flow for the project is 2,200 cfs.

Given the subjective nature and variety of design flow methodologies available, an alternative concept would be to evaluate river hydrology with respect to the 90% passage criteria (10% exceedance) stated above. Using the hydrologic data provided by the USACOE "Fish Passage Investigation – Daguerre Point Dam – Yuba River, California – Preliminary Draft," dated June 20, 2000, the fish passage design flow can be approached in an entirely different manner. Throughout the period of record in which flow was measured downstream of the dam (1942-1997), the monthly flow in the Yuba River was less than 2,000 cfs to 9,000 cfs, for 90% of the time. Even in the month of the greatest 10% exceedance flow, the required fish passage design flow would be 900 cfs, a significant reduction from the former method.

Nonetheless, since the former approach is most conservative, it is used herein as the basis for assessing the viability of respective concepts and is applied to the identification and conceptual layout of physical and operational requirements throughout this evaluation.

In advance of proceeding with a final design, a collaborative process should be conducted with the appropriate fish passage expertise assembled as a technical team from NFMS, CDFG, etc., to establish and review fish passage design criteria (upstream and downstream) methodology and preliminary design.

IV. ALTERNATIVE CONCEPTS EVALUATION

An extensive list of alternative concepts was developed for the subject evaluation and presented by the Working Group as a "*Draft Alternative Description,*" dated March 11, 2002 (Appendix A). Through additional consultation and collaboration amongst the Working Group, selected alternative concepts were subsequently "short-listed" and furnished to Wood Rodgers for evaluation. This list provides the basis for the format and content of the evaluation presented herein. A brief description of each alternative concept is provided followed by an engineering-based evaluation explaining the composition, requirements, and capabilities of the alternative concept and a summary of the benefits and limitations. Where appropriate, drawings are provided to illustrate the physical layout and configuration. The alternative concepts evaluated include:

1. No Action
2. New Fish Passage Facilities
    a. New Fishways at Existing Locations
    b. Alternate Fishway Systems
        (1) New Fishways at New Locations
        (2) Low-Head Weirs Downstream of Dam
3. Notch Dam to Passable Height
4. Natural River Channel Bypass around Dam
    a. Natural Bypass Channel – Short Reach
    b. Natural Bypass Channel – Long Reach
5. Remove Dam
    a. Remove Dam/New Screens and Pump Stations
    b. Remove Dam/Relocate Points of Diversion

ALTERNATIVE NO. 1 - NO ACTION

Introduction

Under the no-action alternative, no additional measures, beyond implementing the biological opinion, would be implemented. The USACOE would continue to operate and manage the dam and affiliated structures according to the current operating protocol. Environmental conditions would remain the same; Daguerre Point Dam and the two existing fish ladders would continue to adversely affect chinook salmon and steelhead.

Summary

With the no-action alternative, the impediments to fish passage would persist. This alternative provides the least construction impact, cost, disturbance of impounded material, and affect on current diversion practices of all available options. However, the no-action alternative would fail to contribute toward the overall goal of the project and would not improve fish passage.

ALTERNATIVE NO. 2.A - NEW FISHWAYS AT EXISTING LOCATIONS

Introduction

Demolishing the existing fish ladders and replacing each ladder with a more conventional fishway system would provide greater conveyance capacity and would better accommodate the diverse hydrologic conditions. New fish ladders of the vertical slot configuration have been proposed and are well suited for this application. From a design objective standpoint, constructing new fishway systems would improve upstream passage by enhancing attraction capabilities at the entrances while continuing to capitalize on the inherent shoreline navigation instincts of adult salmonids (Bates, 2-2).[3] The primary accomplishments of this alternative concept would be to maintain upstream water supply provisions and to improve and facilitate upstream passage of adult salmonids. This alternative concept would not address downstream fish passage objectives.

Description of the Proposed Alternative Concept

This alternative concept consists of two new fish ladders, two new auxiliary water supply systems, independent control systems, and a new relocated headworks structure for the Hallwood-Cordua diversion. The existing fish ladders would be demolished and replaced by the new facilities within the approximate footprints of the existing ladders. The new ladders would be specifically tailored to encourage and assist adult fish in migrating from downstream to upstream of the dam with less delay and injury impacts than the current ladder configurations. Replacing the existing fish ladders with new fishway systems would primarily serve to improve upstream migration while avoiding significant changes to the water supply operations immediately upstream of Daguerre Point Dam. In addition, this alternative concept would not require disturbing sediments impounded upstream.

The new fishway systems proposed in this alternative concept would consist of reinforced concrete fish ladders of the vertical slot configuration and integrated auxiliary water supply systems. The fish ladders could be designed and constructed using the spatial limits of the existing ladders, as illustrated Drawing Alt-2A. The fish ladder configuration applied is consistent with the configuration selected by the USACOE in its preliminary study. Vertical slot fish ladders are commonly used in California, and throughout the Pacific Northwest and the Great Lakes, and are nearly as widely employed as pool-and-weir type ladders due to the standardized configuration. Since vertical slot fish ladders are hydraulically self-regulating, the ladders are well suited for this particular application where fluctuations of headwater and tailwater conditions are expected to occur.

The structural configuration of a vertical slot fish ladder consists of a sloped, rectangular channel partitioned by vertical slot baffles (Drawing Alt-2A). The baffles are located at uniform increments to create a step-like arrangement of resting pools. The fish ladders are typically constructed of reinforced concrete employing a standard baffle configuration to produce hydraulic stability within each pool. The design is self-regulating and provides virtually constant velocities, flow depths, and head differentials at each baffle throughout the range of operating conditions.

Each baffle is configured with a directional slot, a sill block, and an upstream baffle projection to prevent flow short-circuiting and energy carry-through. The fish ladders would allow adult fish passage at any depth within the water column. The fish ladder entrances and exits would be arranged flush with the existing dam abutments and headworks structure. The entrance pools would be configured to include multiple orifices with manually operated slide gates. Fourteen orifices would be aligned with flow perpendicular, and one would be aligned with flow parallel with the river channel. Multiple slide gates would allow for selective manipulation to provide optimum fish attraction conditions. The entrance pools would be arranged integrally with the proposed auxiliary water supply systems and diffuser structures, to enhance the detection of entrance ports by upstream migrants. The redundancy of orifices would provide multiple operating points to facilitate fish detection in the turbulent environment of the tailrace.

A nearly constant 21-foot head differential exists across the dam throughout the range of design flows. With this head differential, the new ladders must be designed to partition the head differential into one-foot increments to conform to commonly used and accepted design guidelines for upstream passage of adult salmonids. Since the required hydraulic gradient of the selected vertical slot fish ladder configuration is one vertical foot for every 10 horizontal feet, each fishway would require a minimum of 210 linear feet. Turn pools and switchbacks would be required due to spatial limitations of the existing fish ladder footprints and as necessary to provide points of discovery near the tailrace of the dam.

The hydraulic capacity of conventional fish ladders is confined to a limited range of approximately 5 cfs to 100 cfs for the head differential of interest. Major increases in the size and depth of fish ladders offer relatively minor increases in conveyance. The design of new fish ladders should be consistent with the basis for defining the design flow parameters and the practicable limitations of the type selected. Since spring-run chinook salmon, fall-run chinook salmon, and steelhead trout maintain overlapping migration patterns, the fishways must provide passage conditions for all subject species throughout the year.

Capacity of the proposed fish ladders should be selected within reason and conventional practice. The balance of fish passage design flow can be best made up through use of auxiliary water supply systems that introduce supplemental flow at the fishway entrances, thus minimizing the size and physical features of the fish ladders. This equates to a more controllable, cost-effective arrangement. Auxiliary water supply systems would maintain operational flexibility and high capacity for the purpose of improving upstream attraction and providing greater passage efficiency. Since the design flow established by the USACOE is 22,000 cfs and typical design standards require 10% of the design flow (2,200 cfs) to be passed through the fishway system(s), the flow must be subdivided into each fishway system (1,100 cfs each) to maintain a 10% flow relationship.

To achieve this condition, the new fish ladders must be augmented using substantial auxiliary water supply facilities to make up the difference between actual fish ladder flow versus required fishway design flow. With this in mind, the fish ladders are configured to convey a continuous, minimum flow of 50 cfs and thereby offer a cost-effective configuration. The auxiliary water supply systems would introduce supplemental water at the fish ladder entrances by modulating inlet control gates with respect to river flow so that a minimum 10% flow relationship is maintained.

Each auxiliary water supply system would include, at the least, a new reinforced concrete intake structure and debris screen, inlet control slide gates and actuators, control instrumentation, four 6-foot-diameter diversion conduits, reinforced concrete diffuser structures, and possibly debris removal trash rake systems (not included). If entrainment prevention of juveniles is required within the auxiliary water supply systems, the cost and feasibility would become impractical and unmanageable in the given environment, therefore the system is designed to accommodate rather than exclude passage of juveniles.

Based upon the fish passage design flow, each ladder consists of an 8-foot-wide by 10-foot-deep by 210-foot-long, reinforced concrete flume with baffles placed every 10 feet. Since guidelines for auxiliary water systems recommend a one-foot per second introduction velocity, subsequently the diffuser structures must be designed at approximately 15 feet deep by 100 feet long. This design is based upon an assumed diffuser submergence of 10 feet (Drawing Alt-2A).

Illegal harvesting at the proposed fish ladders would be addressed by completely covering the fishways with steel grating.

Construction Considerations

Presented below are primary considerations related to construction of the proposed project:

- Access Roads – Access is required on both sides of the river to perform construction of the project. Existing vehicular access is available to both sides of the river, however, the established roads and trails would require upgrading for use during construction. Changes to the road alignments would likely be required to facilitate ingress and egress by large trucks and trucks with trailers. Measures to control dust would be implemented during construction. Access for construction of the fishway on the east bank would be relatively easy to provide. Access for construction of the fishway on the west bank would require improved access between the river and the existing canal.

- Contractor(s) Staging Areas – Work would be performed on each side of the river in separate construction seasons. A construction staging area of approximately two acres would be required throughout the course of construction for purposes of setting up a construction office (trailer), worker vehicle parking, and storage of construction equipment and materials. Electric power would be brought to each area. The staging area would be fenced and locked with security provision. Specific areas would be designated for hazardous material storage and/or refueling operations.

- Cofferdam – A cofferdam would be required to isolate the entire area to facilitate construction of the new fishway. The cofferdam could be constructed while maintaining the ability of the districts to continue diverting water. To minimize the introduction of turbidity into the water, it is anticipated the cofferdam would be constructed following one of two approaches. One approach is to use large fabric bags filled with gravel and placed of sufficient width and length to direct the river flow to spill over the dam along the dam crest outside the notched area. The second approach would involve a similar alignment, however, could be constructed by "pushing out" material available locally. To the extent the deposited bed material permits, the contractor may also consider vibrating in steel sheet piles for the cofferdam on the upstream side of the dam. These would be especially suitable for use for the cofferdam on the west bank. Work for constructing the ladder entrance would be performed by working off the downstream apron of the dam.
- Dewatering Work Area – The work area for constructing the new fishways would need to be dewatered to prepare the foundation and to place the concrete. Water would be pumped from the work area. The water pumped would be discharged into sediment basins where water would percolate readily and prevent sediment from entering the river.

- Fishway Construction – Construction of the fishways would be of conventional construction with widely available equipment and labor, and would include earthwork, reinforced concrete construction, pipeline installation and fusion, miscellaneous mechanical and metalwork installation, electrical controls, and associated electrical services. The construction of this alternative concept would have to be implemented in two separate phases and likely two construction seasons from July through October. Concrete would be supplied from a supplier in the area.

All areas temporarily disturbed by construction would be restored to pre-project conditions. Existing roads would be regraded and/or graveled, as appropriate, or deemed necessary for its pre-project use and future use as related to the project. Staging areas would be re-shaped and graded to prevent ponding of water, re-planted with suitable vegetation, and protected with other erosion control measures, if necessary, to prevent turbid runoff from escaping the site. Areas permanently disturbed by construction generally do not require restoration. However, permanent cut slopes would be shaped, graded, and vegetated, as appropriate, to ensure the slopes remain stable and do not allow turbid waters to escape from the site.

Engineering Requirements

Essential engineering information and data required to prepare final contract documents for this alternative concept includes, but is not limited to, gathering geotechnical data (soil and foundation conditions); performing localized field surveys reflecting current topographical conditions; acquiring as-built drawings that define composition, dimensions and quantities of existing facilities; identifying existing utilities available at the project sites; characterizing debris and sediment transport conditions; obtaining current operation and maintenance plan(s) and objectives from diversion stakeholders and USACOE/DWR; identifying environmental mitigation measures related to construction; and establishing final design criteria as required by the regulatory agencies.

Cost

Land acquisition would not be required by this alternative concept for the additional footprint of the new fishway systems. Using the USACOE's preliminary estimate (neglecting costs for fish screen facilities, Appendix D[20]) and developing an order of magnitude cost based upon gross quantity take-offs and unit prices, the cost for design and construction of this alternative concept is estimated at $5.5 million. This includes a 25% construction contingency, 15% for engineering and design, 15% for construction management, and 5% for mobilization and demobilization, but does not include environmental compliance and permitting costs. The estimated cost for operations and maintenance of the new facilities is $200,000 annually.

Limitations

Although this alternative concept has the potential to improve upstream fish passage conditions at the site, it fails to address some of the objectives of the Project. Attraction flows at the proposed facilities would continue to compete with plunging flow over the dam under high flow conditions. Since operation of the new fishway entrances would offer relatively limited spans and locations of attraction in contrast to continued flow releases over the 575-foot-wide ogee dam crest, the factor of competition would be present at higher flows. During the period from September through November when adult fall-run salmon are migrating upstream, the historic daily flow is less than the fish passage facility design flow of 2,200 about 90% of the time. Whenever the flow is less than 2,200 cfs, the facility would would be operated to carry all of the flow (less diversions) without any water flowing over the dam that could attract migrating adults. In late winter and spring when adult steelhead and spring-run salmon are migrating, the facility would carry all of the flow between 30-60% of the time.

The alternative concept would force upstream migrants to exit near the crest of the dam and possibly create conditions conducive to disorientation and fall back if water was flowing over the dam. The potential for fall back would exist for upstream migrants exiting the fishways being captured within high, transverse velocities sweeping over the dam. Due to the close proximity of the proposed exit locations relative to the dam, reaction time for reorientation is limited, and velocity conditions and magnitudes may not be favorable during high flows. Training walls could help alleviate the issue.

This alternative concept fails to address the downstream fish passage objective. Since the new fishways would redirect only a fraction of the river flow (10% maximum), most of the flow in the Yuba River would continue to pass over the dam. It is unlikely this alternative concept would significantly influence or attract downstream migrants as they approach the dam crest under all river flows. Consequently, juvenile salmonids and kelt steelhead would continue to be subject to injury when passing over the dam. It is expected the predominant downstream passage trends would continue over the dam. This situation could be mitigated to a large extent with the inclusion of spillway gates of not more than two feet in height. Moreover, scour pool conditions at the base of the dam would remain unchanged, resulting in continued potential disorientation and predation losses.

Debris and sediment blockage would continue to compromise functional reliability and would continue to require periodic maintenance. Maintenance demands would likely be exacerbated over existing conditions, as the opportunity for debris and sediment blockage would increase given the incorporation of additional intake and diffuser facilities for the auxiliary water supply systems. These conditions would continue to be a recurring problem relative to river hydrology.

Benefits

The greatest advantage this alternative concept offers to upstream fish passage is the substantial increase in attraction flow at the proposed fishway systems. The new fishway systems would convey up to 2,200 cfs combined flow versus the 50 cfs currently provided by the existing fish ladders. The increase in conveyance capabilities could have a positive affect on directing upstream migrants to negotiable passage routes more quickly. The physical locations of the new fishways, being adjacent to the margins of the Yuba River channel, would also capitalize on the bank line navigational instincts of upstream migrant salmonids to intercept migration routes prior to reaching the tailrace of the dam. Another benefit to upstream migration is that grating-covered fishways would prevent illegal harvesting of adult salmonids within the structures.

With respect to upstream surface water diversion capabilities, this alternative concept would allow Daguerre Point Dam to remain undisturbed. Gravity diversions upstream of the dam would continue as a viable water supply method for the water districts. The existing diversions and fish screen facilities would not be rendered inoperable or obsolete by this alternative concept. However, the Hallwood-Cordua point of diversion at the dam would be relocated slightly.

Additional benefits to this alternative concept are minimization of habitat and fisheries disturbance during construction, resilience to flood damage, and minimized disturbance of impounded bed material.

Summary

This alternative concept offers some potential to improve upstream fish passage but does not satisfy the design objectives for downstream fish passage. This alternative would improve upstream fish passage to a degree by increasing fishway flow and attraction. In addition, this alternative concept would minimize environmental impacts, limit disturbance of upstream sediment, and maintain hydraulic conditions necessary for upstream surface water diversion. It does not resolve issues related to injury from passage over the dam without the inclusion of spillway gates, predation, and operational reliability due to debris and sedimentation blockage. This alternative concept would have little to no affect on downstream flooding and diversions upstream of the dam.

ALTERNATIVE NO. 2.B.1 - NEW FISHWAYS AT NEW LOCATIONS

Introduction

The concept of incorporating supplemental fishways in the center of the dam has been proposed to benefit upstream fish passage while maintaining the physical presence of the dam. This alternative concept would involve constructing permanent concrete fishway structures at strategic locations across the dam, to gradually transition the water surface differential from the forebay to the tailrace. The proposed fishways would provide greater hydraulic capacity than the existing ladders and would better accommodate the diversity of hydrologic conditions. The primary focus of this alternative concept would be to maintain upstream water supply provisions and to improve and facilitate upstream passage of adult salmonids in a manner that targets the ability of the species to respond to particular hydraulic conditions. This alternative concept only marginally addresses downstream fish passage objectives.

Description of the Proposed Alternative Concept

A single conventional fish ladder would not accommodate the full range of operating conditions up to the maximum fishway design flow of 2,200 cfs. Therefore this alternative concept requires multiple ladders and auxiliary water supply systems to satisfy upstream passage objectives. Two types of fishway configurations are available for this application, either a pool-and-weir type or a pool-and-chute configuration. A pool-and-weir-type fish ladder or ladders are not practical for this application, as the ladders would not function well under the wide range of design flow conditions and stage fluctuation. In addition, since the pool-and-weir fish ladder is typically used with deep pools for energy dissipation and orifices for variability of flow, the debris and sediment/bed load of the Yuba River would render this type of fish ladder unreliable and require a high degree of maintenance. Accordingly, this alternative concept is evaluated with a pool-and-chute-type fish ladder.

The pool-and-chute-type fish ladder is a hybrid configuration that operates as a pool-and-weir under low flow conditions and a roughened chute under high flow conditions. The economy of this concept is achieved by exceeding the usual fish ladder pool volume criteria based upon energy dissipation in each pool. At low flow, this type of fish ladder creates a hydraulic pattern that utilizes plunging flow hydraulics through baffle notches to step down the head in uniform increments from the upstream to the downstream levels. Under high flow conditions, the hydraulic gradient follows a uniform slope. The majority of flow passes through the center of the fish ladder over the baffle walls in a streaming hydraulic pattern at greater depth.

Although this type of fishway has the potential to achieve the fish passage design flow objectives, the design is not recommended for use where a total head differential exceeds six feet. Physical model testing must be performed to confirm design compatibility with this application. If model testing reveals the pool-and-chute design is suitable for upstream fish passage in view of the hydraulic operating conditions, the pool-and-chute fish ladder type is a definite candidate for consideration. The operating characteristics of this particular ladder design are much more conducive to debris passage than other types, due to its open configuration.

Assuming model testing indicates the pool-and-chute design is appropriate for this application, the alternative concept must be arranged to satisfy design flow requirements. A single pool-and-chute fish ladder can provide fish passage over a wide range of flow conditions and can convey up to 500 cfs. A combination of three new fish ladders and two auxiliary water supply systems could conceivably accommodate the fishway passage design flow of 2,200 cfs while providing good flow control relative to river hydrology. With each new fish ladder conveying up to 500 cfs, the balance of fish passage design flow would be provided by auxiliary water supply systems contributing up to 350 cfs each. The auxiliary water supply systems would operate in tandem with the fish ladders to maintain a flow proportion equal to 10% of Yuba River flow, up to 22,000 cfs.

Drawing Alt-2B1 illustrates the proposed facilities layout required by this alternative concept. This alternative concept would consist of three pool-and-chute fish ladders located at the ¼, ½, and ¾ length points along the crest of the dam. Two auxiliary water supply systems would be incorporated within existing abutments at the opposite ends of the dam, and the discharges would be integrated within the entrance pools of the two new outermost fish ladders.

Applying a design precedent used on a Nooksack River tributary in Washington (Bates, Figure 6-17)[3] as the basis for configuring this alternative concept, each pool-and-chute fish ladder would consist of a reinforced concrete flume roughly 30 feet in width partitioned by an incrementally spaced baffle network. The structure profile would be designed at a 14% slope, thereby requiring a fishway that is 185 feet long and projects upstream approximately 50 feet. If the switchback variation of the pool-and-chute design proves successful during model testing, it could reduce the physical size of the structure by more than 30% in length from a conventional pool-and-chute ladder. Each ladder would force flow to follow a circuitous pattern at low flow by creating a step-like arrangement of resting pools and hydraulic stability within each pool. High flow would be concentrated along the centerline of the ladder, and passage potential must be verified through model testing to assess adequacy of flow velocities and availability of resting zones due to the steep hydraulic gradient.

The baffle network is configured in a staggered pattern with a sloped top edge and integrated weir notch. The fish ladder entrances are arranged nearly flush with the downstream edge of the dam apron to facilitate entry. The entrance pools are configured to provide a full width opening. The exits project approximately 50 feet upstream of the dam crest and would include a debris deflector to minimize blockage. The exits would also include fish-negotiable trash racks with member spacing in accordance with conventional design practice. The tops of the ladder walls should be designed to extend a minimum of three feet above the calculated flow profile at maximum design capacity. The outermost entrance pools are arranged integrally with the proposed auxiliary water supply systems and diffuser structures, to enhance detection at the entrances by upstream migrants.

To accommodate the entire design flow, the new fish ladders must be augmented with auxiliary water supply facilities to make up the difference between actual fish ladder flow and the required fishway design flow. The auxiliary water supply systems would offer operational flexibility and high capacity for the purpose of improving upstream migrant attraction of upstream migrating fish and providing greater passage efficiency. The auxiliary water supply systems would introduce supplemental water at the fish ladder entrances by modulating inlet control gates with respect to river flow so a 10% flow relationship is maintained.

Each auxiliary water supply system would include, at a minimum, a new reinforced concrete intake structure and debris screen, inlet control slide gates and actuators, control instrumentation, two five-foot-diameter diversion conduits, reinforced concrete floor diffuser structures, and possibly debris removal trash rake systems (not included). Since guidelines for floor diffusers recommend a one-half-foot per second introduction velocity, the diffuser structures must be approximately 30 feet wide by 25 feet long (Drawing Alt-2B1). If entrainment prevention of juveniles is required within the auxiliary water supply systems, the cost and feasibility of incorporating fish screens would render this alternative concept impractical and unmanageable in the given environment, therefore the system is designed to accommodate passage of juveniles.

The entire open area at the top of the fish ladder would be covered to keep debris out of the ladder and to prevent illegal harvesting of fish in the ladder. The existing ladders could be covered and remain in operation or filled in and taken out of service.

Construction Considerations

Presented below are primary considerations related to construction of the proposed project:

- Access Roads – Access is required to both sides of the river to perform construction of the project. Existing vehicular access is available to both sides of the river, however, the established roads and trails would require upgrading for use during construction. Changes to the road alignments would likely be required to facilitate ingress and egress by large trucks and trucks with trailers. Measures to control dust would be implemented during construction. Access for construction of the fishways in the center of the dam and on the east bank would be relatively easy to provide. Access for construction of the fishway on the west side of the dam would require improved access between the river and the existing canal.

- Contractor(s) Staging Areas – Work would be performed on each side of the river in separate construction seasons. A construction staging area of approximately two acres would be required throughout the course of construction for purposes of setting up a construction office (trailer), worker vehicle parking, and storage of construction equipment and materials. Electric power would be supplied to each area. The staging area would be fenced and locked with security provision. Specific areas would be designated for hazardous material storage and/or refueling operations.

- Cofferdam – A cofferdam would be required to isolate the entire area to facilitate construction of the new fishway. The cofferdams could be constructed while maintaining the ability of the districts to continue diverting water. To minimize the introduction of turbidity into the water, it is anticipated the cofferdam would be constructed following one of two approaches. One approach is to use large fabric bags filled with gravel and placed of sufficient width and length to direct the river flow to spill over the dam along the dam crest outside the notched area. The second approach would involve a similar alignment, however, could be constructed by "pushing out" material available locally. To the extent the deposited bed material permits, the contractor may also consider vibrating in steel sheet piles for the cofferdam on the upstream side of the dam to minimize underseepage into the work area.
- Dewatering Work Area – The work area for constructing the new fishways would need to be dewatered for preparing the foundation and placing concrete. Water would be pumped from the work area. The water pumped would be discharged into sediment basins where water would percolate readily and prevent sediment from entering the river.

- Notching the Dam – The dam would have to be "notched" for construction of the three fish ladders. Equipment used to construct the notch would generally operate off the concrete apron on the downstream side of the dam. Air-track drilling equipment and concrete splitters would likely be used to fracture the concrete to facilitate removal. Access to the downstream side of the dam should be readily available. This would facilitate loading and removing the concrete. It is anticipated the dam is mass concrete without reinforcing steel in which case it would be appropriate to crush the concrete and recycle it as road base or other construction material. The crushed concrete could be used as surfacing for the roads to access the pump station and diversion dam in the future.

- Fishway Construction – Construction of the fishways would be of conventional construction with widely available equipment and labor, and would include earthwork, reinforced concrete construction, pipeline installation and fusion, miscellaneous mechanical and metalwork installation, electrical controls, and associated electrical services. The construction of this alternative concept would have to be implemented in two separate phases and likely two construction seasons from July through October. Concrete would be supplied from a supplier in the area.

All areas temporarily disturbed by construction would be restored to pre-project conditions. Existing roads would be regraded and/or graveled, as appropriate, or deemed necessary for its pre-project use and future use as related to the project. Staging areas would be re-shaped and graded to prevent ponding of water, re-planted with suitable vegetation, and protected with other erosion control measures, if necessary, to prevent turbid runoff from escaping the site. Areas permanently disturbed by construction generally do not require restoration. However, permanent cut slopes would be shaped, graded, and vegetated, as appropriate, to ensure the slopes remain stable and do not allow turbid waters to escape from the site.

Engineering Requirements

Essential engineering information and data required to prepare final contract documents for this alternative concept includes, but is not limited to, conducting physical model studies of the proposed fish ladder concept; gathering geotechnical data (soil and foundation conditions); performing localized field surveys reflecting current topographical conditions; acquiring as-built drawings that define composition, dimensions, and quantities of existing facilities; identifying existing utilities available at the project sites; characterizing debris and sediment transport conditions; obtaining current operation and maintenance plan(s) and objectives from diversion stakeholders and USACOE/DWR; identifying environmental mitigation measures relating to construction; and establishing final design criteria required by the regulatory agencies.

Cost

Land acquisition would not be required by this alternative concept for the new facilities. Developing an order of magnitude cost based upon gross quantity take-offs and unit prices, the cost for design and construction of this alternative concept is estimated at $5 million. This includes a 25% contingency; 25% for engineering, design, and physical model studies; 15% for construction management; and 5% for mobilization and demobilization, but does not include environmental compliance and permitting costs. The annual operations and maintenance cost associated with the new facilities is estimated at $250,000.

Limitations

Although this alternative concept has the potential to improve upstream fish passage conditions at the site, the concept has not been field-proven for this particular application and would have to be model-studied prior to implementation. In addition, this alternative concept fails to address some of the other problems associated with upstream fish passage. The proposed facilities continue to compete with plunging flow over the dam during high-flow conditions. Since the proposed fish ladders would only consume approximately 15% of the total dam crest, competition for attraction would remain an issue relative to continued flow over the 575-foot-wide dam under these flows. During the period from September through November when adult fall-run salmon are migrating upstream, the historic daily flow is less than the fish passage facility design flow of 2,200 about 90% of the time. Whenever the flow is less than 2,200 cfs, the facility would would be operated to carry all of the flow without any water flowing over the dam that could attract migrating adults. In late winter and spring when adult steelhead and spring-run salmon are migrating, the facility would carry all of the flow only about 30-60% of the time.

This alternative concept fails to adequately address downstream fish passage. Since the new fishways would only redirect a fraction of the river flow (2,200 cfs maximum), there would be high-flow periods when most of the Yuba River flow passes over the dam. It is unlikely the new fishway systems would significantly influence or attract downstream migrants as they approach the dam crest under higher river flows. Consequently, injury could continue to be subjected to juvenile salmonids and kelt steelhead as they pass over the dam. This could be mitigated to a large extent with the inclusion of spillway gates of not more than two feet in height. Limited opportunity for juvenile discovery and potential for fall back would exist since the fish ladder exits would project 50 feet upstream of the dam crest. Consequently, downstream passage would predominantly occur over the dam. Scour pool conditions at the base of the dam would remain unchanged, therefore disorientation and predation could continue at the tailwater pool.

The new fish ladders would be vulnerable to flood damage and debris/sediment blockage, which would compromise functional reliability. Access to the ladders would be difficult and performing routine maintenance to keep the ladders functional would be difficult as well as present safety concerns. Maintenance demands would be greater than existing conditions, as the opportunity for debris and sediment blockage associated with the intake facilities for the auxiliary water supply systems would increase maintenance requirements also. These conditions would be a recurring problem relative to river hydrology. In addition, accessibility would be an issue for a substantial part of each year relative to administering the maintenance required to keep the new fish ladders functional. Furthermore, changing river geomorphology may affect the functional ability of the new fish ladders over time.

Construction would require demolition of portions of the dam, potentially disturbing sediment impounded upstream. Risks associated with in-channel work can be a factor during construction due to unforeseeable hydrologic events and the locations of the work.

Benefits

This alternative concept offers significant advantages to upstream fish passage by increasing attraction flow. Providing multiple points of attraction over the full width of the river channel would maximize the opportunity, thus efficiency of fish passage. The new fishway system conveys up to 2,200 cfs combined versus the combined 50 cfs currently provided by the existing fish ladders. The increase in fish ladder conveyance and the provision of additional passage routes could have a positive affect on the passage of upstream migrating fish. The physical locations of the new fish ladders would provide good margin-to-margin coverage of the Yuba River channel and enable upstream migrants to detect passage opportunity more readily. Given the fish ladder entrances are located at the downstream face of the dam, there is a reduced chance fish would miss the passage routes by swimming beyond them. Additionally, the alternative concept would be beneficial for upstream migrants as the new fish ladders would be covered with steel grating to prevent illegal harvesting of adult salmonids and minimize debris fallout within the ladders.

Under this alternative concept, the existing fish ladders could continue to be used. With continued use of the existing fish ladders, this alternative concept promotes a high degree of attraction coverage and would provide improved upstream fish passage efficiency over existing conditions. This alternative concept would not require demolition of the existing ladders.

From the standpoint of downstream fish passage, it is reasonable to assume this alternative concept would provide some benefit to downstream fish passage by increasing attraction currents at the fish ladder exits, thus improving discovery potential toward safer downstream passage routes. However, the sphere of influence would be isolated to relatively small, localized regions.

With respect to upstream surface water diversion capabilities, this alternative concept allows Daguerre Point Dam to remain undisturbed and the existing gravity diversions upstream of the dam to continue under its present operation.

Additional benefits to this alternative concept are minimization of habitat and fisheries disturbance during construction and minimization of operating demands.

Summary

This alternative concept has the potential to improve upstream fish passage if the design concept shows favorable passage conditions from results of physical model studies. This alternative concept, however, would not resolve all incidences pertaining to injury from passage or attempted passage over the dam without the inclusion of spillway gates or incidences of predation, and would not improve operational reliability due to debris/sediment load and limited access. It would maintain hydraulic conditions necessary for upstream diversion but would involve some disturbance of sediment upstream of the dam. Access to the proposed facilities and safety associated with operation and maintenance are also important issues to consider. The capacity of the structure to pass high flow should not be affected.

ALTERNATIVE NO. 2.B.2 – LOW-HEAD WEIRS DOWNSTREAM OF DAM

Introduction

Construction of a series of full-width reinforced concrete/roller-compacted concrete weirs downstream of Daguerre Point Dam would partition the approximately 21-foot head differential across the dam into one and one-half foot increments. The weirs would be constructed across the entire Yuba River channel and anchored into existing bedrock foundation material, assuming such material exists at the riverbanks. The series of weirs would produce a step-pool arrangement conducive to fish passage by proportioning the total hydraulic gradient thereby creating stream flow velocities that would be negotiable by upstream fish. In addition, the weirs would collectively function as grade control structures to maintain the desired function of surface water impoundment and sediment containment upstream of Daguerre Point Dam.

Description of the Proposed Alternative Concept

This alternative concept involves constructing a series of low-head weirs across the river downstream of the dam. This alternative concept universally addresses upstream and downstream fish passage objectives by providing a full river width solution that recreates commonly encountered, natural in-stream conditions.

Grade control structures as proposed have been commonly used to establish stable grades in eroding streams. Low-head weirs provide the same benefits of traditional grade structures and can also provide riffle and pool habitat, establish desired substrate characteristics, and generate preferred hydraulic conditions for fish passage. The low-head weir concept has been widely used by the USACOE and USBR for remediating artificial obstacles in streams and river channels and for stream habitat restoration as well.

Low-head weirs are most commonly used in stream restoration work to deflect and concentrate flow toward the center of the channel downstream of the weir, thus reducing potential for bank scour and providing some level of local bank protection. The system is used to dissipate excess energy in a manner that offers fish negotiable hydraulics and does not compromise the physical integrity of the stream channel. Scouring naturally tends to occur immediately downstream of the weirs where velocities and turbulence are greatest. As the velocities decrease and stabilize, sands and finer sediment would be deposited in the downstream direction. The size and development of the scour holes is self-regulating and limited, as it is controlled by backwater effects of subsequent downstream weirs. The scour holes create a staging pool for upstream migrants that further facilitate the upstream movement of fish.

Low-head weirs are typically designed to provide river stability. However, in this particular application a series of evenly spaced weirs would also generate hydraulic conditions suitable for fish passage. From a hydraulic standpoint, this alternative concept would provide grade control and hydraulic characteristics favorable for fish passage under the entire range of design flow conditions. This alternative concept would allow upstream and downstream migrants to pass the modified reach at any point in the flow cross section, and therefore would not impose delay or injury by forcing fish to find a limited passage route. The series of weirs would produce subtle transitions across the length of the weirs and create more natural hydraulic conditions that are negotiable for upstream migrants. The low-head weirs would not disorient or injure downstream migrants. The opportunity for fish to seek suitable hydraulic conditions for upstream passage would exist throughout a wide range in flows. A combination of plunging flow and streaming flow conditions would be provided to offer upstream migrants the option of selecting passage locations that are in line with usual behavioral preferences.

For the proposed fish passage system to be reliable, structural integrity must be absolute throughout a full range of actual hydrologic conditions within the Yuba River. The performance of each weir is directly dependent upon the grade control performance and stability of the next successive downstream weir. The design of this alternative concept is critical with respect to maintaining individual structural integrity and thereby channel stability. In engineering terms, design of the grade control system is a function of the type of in-situ material or channel lining, flood flow frequency, permissible velocity, and boundary shear stress. The effects of scour and sedimentation on the proposed system must be evaluated beforehand so fish passage and grade control capabilities meet established objectives. The structural integrity of the weir system would depend upon preventing excessive scour, channel incision, and flanking. A properly designed system would reach a state of equilibrium relative to scour and sedimentation. The residual material remaining within the pools would likely consist of boulders and cobbles.

The major physical characteristics of the low-head weir system pertain to configuration, weir spacing, and riprap sizing. The alternative concept layout and weir configuration are illustrated on Drawing Alt-2B2, Sheets 1 and 2. The design of low-head weirs typically consists of a chevron configuration with an interior angle of 120 degrees. However, since this alternative concept requires weirs of substantial length, the weir would be designed in a mild arc or vee-shape configuration through a portion of the weir length. Structural capabilities of the system would need to be considered with respect to flow and bed load. The vertical profile of each weir would include a constant upward slope from the centerline outward to concentrate flow toward the center of the river channel although this should be examined in detail along with the horizontal configuration. The vee-shape profile of the weirs would provide greater depth for fish passage at low flows and would aid in maintaining desired velocity field distribution offering higher centerline and lower margin velocities.

The primary objective of the proposed weir system is to provide a controlled hydraulic gradient that accommodates fish passage over the existing dam, therefore the spacing and downstream gradient of the weirs must be calculated. A maximum gradient of four percent is generally accepted as the upper threshold.

The weirs would be progressively offset in elevation from the downstream point of origin to the dam crest in one and one-half foot increments. Based upon the selected offset, 15 weirs would be constructed every 60 feet to integrate the entire system within the limited reach of the defined western embankment. Although a head differential of one foot is typically a recommended maximum for fish ladder design, given the fact that the proposed alternative concept is not a confined structure and the swimming characteristics and leaping abilities of the salmonid species are quite good, it is suggested relaxing this criteria to provide an economically viable alternative concept. By designing a weir system to partition the overall head at a lesser head differential increment, more weirs are required and the system reach may extend beyond the downstream limit of the western embankment. Additionally, a weir system constructed using a one-foot head differential may become economically prohibitive, as the cost of each weir is considerable and the channel boundaries diverge considerably downstream beyond the proposed reach of the system.

The length of the weirs is contingent upon the top width of the water column at the maximum probable flood event. The weirs would be keyed into the opposing embankments to prevent flanking and subsequent channel incision. The points of weir/embankment interface would be protected by an armoring layer of riprap constructed to a height of three feet above the maximum design criteria water surface elevation. The potential for channel incision would be minimized by installing riprap at the side slopes of the river channel and by keying the weirs into the embankments.

The size of stones required for adequate protection would be determined using the USACOE's publication EM 1110-2-1601. Conservative values would be applied since larger stones are less prone to result in design error than stones that are too small. In addition, the armoring course would be underlayed with a geotextile to prevent hydrostatic uplift pressure, migration of fines, and subsequent erosion. The USACOE sizes riprap and material gradation on side slope revetments based upon river velocity. This includes an appreciable factor of safety to account for debris impact. The thickness of the revetments would be determined by the following: one (1) times d_{100} or one and a half (1½) times d_{50}, whichever is greater.

Since the proper operation of each weir is directly dependent upon the stability of the next successive downstream weir, the weirs would be designed as independent structures. Significant undermining or movement would be avoided by designing the weirs accordingly. The concrete weirs would extend down to the existing strata of bedrock to serve as a hydraulic cut-off and to provide weir stability.

Construction Considerations

Presented below are primary considerations related to construction of the proposed project:

- Access Roads – Access is required to both sides of the river to perform construction of the project. Existing vehicular access is available to both sides of the river, however, the established roads and trails would require upgrading for use during construction. Changes to the road alignments would likely be required to facilitate ingress and egress by large trucks and trucks with trailers. Measures to control dust would be implemented during construction.

- Contractor(s) Staging Areas – Work would be performed on both sides of the river most likely in two construction seasons. Accordingly, staging areas of about two acres would be required throughout the course of construction for purposes of setting up construction offices (trailers), worker vehicle parking, and storage of construction equipment and materials. Electric power would be supplied to each area. The staging area would be fenced and locked with security provision. Specific areas would be designated for hazardous material storage and/or refueling operations. To the extent the contractor elects to set up a batch plant on the east bank for the first year construction an additional acre of land may be needed for the batch plant and storage of materials. It is anticipated construction of the weirs would be on the east side of the river the first season and the west side the second season. It is not anticipated that an on-site batch plant would be considered for the second season and material would be purchased from concrete suppliers in the area.

- Control of River – Work would proceed on the east side the first year, therefore, the river would be directed to the west side to the greatest extent possible. Sand bags could be set on the crest of the dam to a height required to direct the river to the west side. This would be reversed the second year when the work would be performed on the west side. It is anticipated approximately 75 percent of the length of the weirs would be constructed from the east side based upon recent aerial photographs of the existing conditions. A hydraulic cutoff to separate the east side from the west side work areas could be created with "tremie" concrete placed parallel to the river throughout the entire length of the work. This would serve to isolate the west side work in the second construction season when the river is redirected to the east side.

- Weir Construction – The work area for placing the roller compacted concrete weirs would need to be dewatered sufficiently to allow placement of the initial layers of concrete on bedrock. In the event the water cannot be controlled for "dry" placement, the initial layers could be tremie concrete and then followed by roller-compacted concrete operations. Water removed from the work area by pumping would be discharged into sediment basins where water would percolate readily and prevent sediment from entering the river. Upon completion of the construction of the weirs, and depending upon the grade of the river at the time of construction, gravel from the area would need to be imported to bring the grade up concurrent with construction of the weirs. A proportionately greater amount of material would need to be imported for construction in the second year.

All areas temporarily disturbed by construction would be restored to pre-project conditions. Existing roads would be regraded and/or graveled, as appropriate, or deemed necessary for its pre-project use and future use as related to the project. Staging areas would be re-shaped and graded to prevent ponding of water, re-planted with suitable vegetation, and protected with other erosion control measures, if necessary, to prevent turbid runoff from escaping the site. Areas permanently disturbed by construction generally do not require restoration. However, permanent cut slopes would be shaped, graded, and vegetated, as appropriate, to ensure the slopes remain stable and do not allow turbid waters to escape from the site.

Engineering Requirements

Essential engineering information and data required to prepare final contract documents for this alternative concept includes, but is not limited to, conducting physical hydraulic model studies of the proposed concept; gathering geotechnical data (soil and foundation conditions); performing field surveys reflecting current topographical conditions; identifying environmental mitigation measures as they relate to construction; and establishing and approving final design criteria required by the regulatory agencies. The physical or hydraulic model would be particularly important to define. At a minimum, a two-dimensional hydraulic model should be prepared to define velocity fields through the system under a variety of flow conditions so the affects of bed load transport and sedimentation processes on functional dependability and the durability of the proposed weir structures can be better understood.

The model would be essential to determine the most appropriate horizontal configuration of the weir as well as spacing as it relates to energy dissipation, scour, deposition, and overall velocity field.

Cost

Land acquisition would not likely be required by this alternative concept for the new facilities, since all work would be conducted within the margins of the Yuba River channel. Developing an order of magnitude cost based upon gross quantity take-offs and unit prices, the cost for design and construction of this alternative concept is estimated at $17.5 million. This amount includes a 25% contingency; 25% for engineering, design, and model studies; 15% for construction management; and 5% for mobilization and demobilization, but does not include environmental compliance and permitting costs. The annual operations and maintenance cost associated with the low-head weir is estimated at $50,000.

Limitations

Although the principals employed in this alternative concept have been applied to other projects, this alternative concept would likely be the first of its size and magnitude for the application of fish passage improvement. As such, there are no former projects to use as a precedent. As a result, the alternative concept design would require, as noted above, a physical model study to assess performance and reliability.

The low-head weir system may be vulnerable to excess sedimentation or scour and may require periodic in-stream maintenance to preserve the spatial limits of resting pool formation and subsequent hydraulic conditions required for fish passage. Access for maintenance activities would be difficult except for periods when in-stream flow is low. Furthermore, changing river geomorphology downstream of the weirs could affect the functional ability of the system over time.

Additionally, the hydraulic efficiency of the ogee crest of Daguerre Point Dam would be altered so the upstream water surface elevation would be slightly greater for a given flow. The extent to which the water surface increase would reach upstream would need to be evaluated.

Benefits

The low-head weir concept offers great potential for satisfying all design objectives. This alternative concept offers significant advantages to fish passage for all life stages by providing negotiable conditions over the entire wetted length of the weirs throughout the entire design flow range. Because the proposed weir system offers a full river width solution, it accommodates 100% of the total fish passage design flow, therefore eliminating the need for fish to detect and locate isolated points of entry. The system of low-head weirs would provide the best margin-to-margin coverage of the Yuba River channel, with the exception of dam removal, and should have a positive affect on fish passage upstream and downstream. This alternative concept offers a more natural condition for fish passage without requiring confined structures and separate passage routes. In addition, illegal harvesting of adult salmonids would likely be no easier within the modified river than in the natural river. From the standpoint of downstream fish passage, this alternative concept could greatly benefit passage by transporting juveniles through a subtle procession of transition pools from the impoundment to the river channel downstream of the weir system. Furthermore, this alternative concept would eliminate the existing tailwater pool and minimize predation and possibly increase usable spawning area.

This alternative concept would serve to incrementally transition the hydraulic gradient from the downstream point of origin to the existing dam crest in a gradual manner, consequently maintaining the impoundment for continued gravity diversion. This alternative concept allows Daguerre Point Dam to remain undisturbed and gravity diversion upstream of the dam would continue to operate as is done currently. The existing diversions and fish screen facilities would not be rendered inoperable or obsolete by this alternative concept. Additionally, sediment upstream of the dam would not be disturbed and would remain in-place.

Since the low-head weir system would be operationally self-sustaining, this alternative concept would require no operational requirements and would require no electrical utilities, equipment, or human intervention. Due to the low profile and durable design of the alternative concept, it is reasonable to assume maintenance demands would be minimal, if required at all.

Additional benefits include minimizing habitat disruption and fisheries disturbance during construction, self-sustaining hydraulic performance, and preventing demolition of the existing fish ladders and dam sections.

Summary

The low-head weir alternative concept offers the greatest potential to satisfy all design and cost objectives, assuming the design concept proves favorable through the application of physical model studies. This alternative concept would keep upstream surface water diverters whole and would not result in disturbing potentially contaminated mercury-entrained sediment. The low-head weir alternative concept offers the best operational reliability with the least maintenance demand. The structural integrity of the interdependent system, resilience to flood damage, and impacts to upstream water surface elevations are the most significant issues for consideration. Flooding effects upstream would need to be evaluated.

ALTERNATIVE NO. 3 – NOTCH DAM TO PASSABLE HEIGHT

Introduction

Notching the crest of the Daguerre Point Dam has been proposed as a means of reducing the 21-foot head differential across the dam to facilitate fish passage. Under this alternative concept a section of the dam would be removed to create hydraulic conditions conducive to fish passage. Notching the dam would improve passage for downstream migrants as well as eliminate the conditions that allow gravity diversions to operate. Excavation of sediment and bed material accumulated upstream of the dam would be required. Additionally, installation of new pump stations would be required to continue water deliveries.

Description of Proposed Alternative Concept

Notching Daguerre Point Dam to facilitate fish passage under the fish passage design flow of 22,000 cfs would require opening a 350-foot section of the total dam length of 575 feet. A portion of the notch would be at the same elevation as the downstream apron of the dam. The overall notch would be stepped to create hydraulic conditions conducive for fish passage through a range of flows. Bed material and sediment deposited upstream of the dam would be excavated from a defined area to create a "geomorphic" channel as described in the report prepared by the USACOE. This alternative concept, similar to complete removal of the dam, may affect a reach of the river extending approximately three miles upstream of the dam. The estimated volume of excavated bed material under notching would be approximately half that removed under the dam removal concept. The river channel would require monitoring to assess for scouring outside of the channel excavation limits.

Lowering the river stages would require constructing pump stations to continue with water diversions. Pump stations would be constructed immediately upstream of the dam with capacities of 750 cfs and 600 cfs on the west and east banks, respectively. The pump stations will be equipped with state-of-the-art fish screens complying with NOAA and CDFG criteria.

The fish screens would be vertical, flat plate (stainless steel wedge wire) with a screen cleaning mechanism. Bypass flows would be required to produce sweeping velocities across the screen face as well as to transport downstream migrants back to the river below the dam.

The alternative concept layout and weir configuration are illustrated on Drawing Alt-3, Sheets 1, 2, and 3.

Construction Considerations

Presented below are primary considerations related to construction of the proposed project:

- Access Roads – Access is required to both sides of the river to perform construction of the project. Existing vehicular access is available to both sides of the river, however, the established roads and trails would require upgrading for use during construction. Changes to the road alignments would likely be required to facilitate ingress and egress by large trucks and trucks with trailers. Measures to control dust would be implemented during construction.

- Contractor(s) Staging Areas – Work would be performed on both sides of the river concurrently. Accordingly, staging areas would be required throughout the course of construction for purposes of setting up construction offices (trailers), worker vehicle parking, and storage of construction equipment and materials. Electric power would be brought in to each area. The staging area would be fenced and locked with security provision. Specific areas would be designated for hazardous material storage and/or refueling operations.

- Cofferdam – A cofferdam would be required to isolate the entire area to facilitate construction of the 250-foot notch in the dam. To minimize the introduction of turbidity into the water, it is anticipated the cofferdam would be constructed following one of two approaches. One approach is to use large fabric bags filled with gravel and placed of sufficient width and length to direct the river flow to spill over the dam along the dam crest outside the area to be notched. The second approach would involve a similar alignment, however, could be constructed by "pushing out" material available locally. Special attention would be required in planning the construction of the cofferdam in relation to excavation of the "geomorphic" channel. To minimize uncontrolled scour of bed material deposited upstream of the dam, excavating the channel would need to be performed concurrent with construction of the notch. As much material as possible would need to be removed in the one construction season. The deposited material, on which the cofferdam is constructed, would for the most part, be removed by the river scouring and transporting the material through the notch during the winter period following completion of the notch.

- Dewatering Work Area – The work area for constructing the notch in the dam would not have to be dry but needs to be dewatered sufficiently to keep water off the apron of the dam where most the construction equipment would most likely be set up. Water would be removed by pumping. The water pumped from the construction area would be discharged into sediment basins where water would percolate readily.

- Notch Construction – Equipment used to construct the notch would generally operate off the concrete apron on the downstream side of the dam. Air-track drilling equipment and concrete splitters would likely be used to fracture the concrete to facilitate removal. Access to the downstream side of the dam should be readily available. This would facilitate loading and removing the concrete. It is anticipated that the dam is mass concrete without reinforcing steel in which case it would be appropriate to crush the concrete on site and recycle it to use as road base or other construction material. The crushed concrete could be used as surfacing for the roads to access the pump station and diversion dam in the future.

- Geomorphic Channel Excavation – Excavating the channel could be accomplished by dredging. To the extent the material could be deposited in the gold mining tailings (Yuba gold fields), the dredged material could be transported either by a slurry pipeline or a conveyor system. A fair degree of flexibility would exist in placing the material by employing either method.

- Pump Stations and Discharge Pipelines – The pump stations would be constructed near the abutments of the dam. Hydraulic analyses of the notch under appropriate flow regimes would provide a reasonable basis to establish the vertical position of the pump station intake and fish screens. It is anticipated, however, that construction of the permanent pump stations would follow construction of the notch by a few years to allow time to observe the behavior of the channel and banks in the vicinity of the dam in advance of constructing the pump stations. A cofferdam would be constructed to isolate the pump station construction site from the active channel. Water pumped from the construction area would be discharged to sediment basins to avoid having sediment enter the river.

  Although it may be prudent to postpone construction of the pump stations, the discharge pipelines could be constructed. Construction of the pipelines could be performed following standard construction procedures. Construction of the pipeline is not expected to create any hazards or risks.

All areas temporarily disturbed by construction would be restored to pre-project conditions. Existing roads would be regraded and/or graveled, as appropriate, or deemed necessary for its pre-project use and future use as related to the project. Staging areas would be re-shaped and graded to prevent ponding of water, re-planted with suitable vegetation, and protected with other erosion control measures, if necessary, to prevent turbid runoff from escaping the site. Areas permanently disturbed by construction generally do not require restoration. However, permanent cut slopes would be shaped, graded, and vegetated, as appropriate, to ensure the slopes remain stable and do not allow turbid waters to escape from the site.

Engineering Requirements

Essential engineering information required to prepare construction documents for this alternative concept include: conducting project management and coordination; performing geomorphologic studies; gathering geotechnical data (soil and foundation conditions); performing extensive field surveys reflecting current topographical conditions; performing hydraulic analyses; acquiring as-built drawings of the existing facilities; identifying existing utilities available at the project sites; further characterizing sediment and bed material transport as part of planning and sequencing construction; identifying environmental management and/or mitigation measures relating to construction, excavation, and/or disposal of sediment and bed material; and establishing final design criteria in consultation with regulatory agencies.

Cost

Elements of the USACOE's dam removal project and alternative concept No. 5.A were utilized in preparing an order of magnitude cost for this alternative concept. The unit costs were reviewed generally and deemed reasonable, however, the quantities were accepted as presented since doing more was beyond the scope and budget for the assignment. The costs for the project were estimated at $63.3 million. The estimated annual operating cost, including pumping costs, are nearly $2 million. This amount includes USACOE's estimated construction management costs, engineering and design costs, prorated to this alternative concept, and a 25% contingency. No costs are included for environmental compliance and permitting.

Not included in this estimate is the cost for disposing excavated material from the riverbed or the cost of maintaining water diversions during construction of the notch and up to the completion of the new pump stations. Real estate acquisition and environmental mitigation costs are also not included. The annual operation and maintenance cost associated with this alternative concept, including energy costs, is $2 million.

Limitations

The size of notch necessary to convey the 22,000 cfs design flow (350 ft.) is greater than half the entire spillway length (575 ft.). Removal of such a large portion of the spillway would likely weaken the dam structure and change the hydraulic conditions at the dam. Upstream migrating fish would need to jump over the stepped notch at the elevation of the dam apron. Some injury to upmigrants may still occur at this location. Predation of outmigrating juveniles is still possible.

The facilities and associated cost to continue existing water diversions until new pump stations are completed are problematic. The time span needed for the channel to stabilize after notch construction to allow permanent pump stations construction is also uncertain. The timing of construction to complete the notch in one construction season is critical. It would not be practical to construct a cofferdam to facilitate work a second season.

Benefits

This alternative concept provides improved fish passage to all life stages. Upstream migration would be possible under a wide range of flows and adverse impacts to downstream migrants would be reduced substantially.

Summary

This alternative concept would improve fish passage; however, the construction of facilities and performing construction so as to minimize environmental impacts from dealing with deposited sediment and bed material is uncertain. The reliability of diversions during construction and until permanent facilities can be constructed is uncertain as well and the associated costs, although not identified, would be high. Disposing of the material removed from the river remains to be addressed.

ALTERNATIVE NO. 4.A – NATURAL BYPASS CHANNEL SHORT REACH

Introduction

The construction of an earthen or naturalized bypass channel has been proposed as a means of providing upstream and downstream fish passage around the dam. This alternative concept involves constructing a headworks control structure and a bypass channel around the east end of Daguerre Point Dam in a pool and riffle arrangement. The proposed bypass channel would be horizontally aligned to limit overall channel length and to have the downstream end conform to the existing tailwater pool. The channel would include low-head stone weirs similar to those discussed for alternative concept 2.B.2, to partition the approximate 21-foot head differential across the dam into one and one-half foot increments in a channel around the dam. The impoundment and existing sediment conditions upstream of the dam would remain unchanged, since the dam would not be disturbed by this alternative concept. Conveyance for fish passage releases would be controlled by the headworks structure to regulate flow in the bypass channel up to 2,200 cfs in proportion to the flow in the Yuba River.

Description of the Proposed Alternative Concepts

The short reach bypass channel alternative concept is a hybrid option combining the fishway design flow requirements with the low-head weir alternative concept. This alternative concept would produce step-pool hydraulic conditions in a diminished capacity from alternative concept 2.B.2. The design of the bypass channel would more closely resemble the application for which low-head stone weirs is most commonly used. The bypass channel would accommodate upstream fish passage using a series of weirs to incrementally proportion the total hydraulic gradient and create hydraulic conditions suitable for fish passage. In addition, the weirs would collectively function as grade control structures to maintain the desired function of surface water impoundment and sediment containment upstream of Daguerre Point Dam.

This alternative concept would provide a negotiable fishway for upstream migrants by rerouting a portion of the Yuba River through a headworks structure and around the east end of Daguerre Point Dam through an open channel. To establish effective fish passage, the design concept must be consistent with the behavior, size, and swimming strength of the target species.

The proposed bypass channel components would be located at the east side of the river channel to preserve the existing Hallwood-Cordua diversion facilities and to avoid construction-related impacts. The bypass channel would be constructed approximately 60 feet wide by 12 feet deep with a triangular cross section and 2.5H:1V side slopes. The triangular configuration would provide better passage conditions during low flows. Using a horizontal channel alignment as shown on Drawing Alt-4A, the channel length must be a minimum of 350 feet long. The proposed channel length equates to a longitudinal slope of six percent. Although the limiting slope for an open channel/stone weir alternative concept is generally recommended not to exceed four percent, a number of roughened stream channels have been built up to an eight percent slope and suggest it is possible to provide passable conditions up to this limit.

The short reach bypass channel concept would incorporate 14 low-head stone weirs every 25 feet to maintain grade stability in the channel and to introduce hydraulic conditions favorable to fish passage. The weirs would provide hydraulic control within the channel rather than simply limiting flow velocities and dissipating energy through boundary roughness. The design of low-head stone weirs includes a chevron configuration of exposed boulders embedded within a concrete weir footing. The weirs are aligned with an interior angle of 120 degrees. Exposed boulders are arranged along the crest of the weirs to break up flow patterns and provide variable hydraulic conditions within the water column. The spacing of weir stones across the channel is typically one and one half feet, or one-quarter to one-half the stone diameter.

The interior angles of the weirs dictate the velocity fields within the downstream vortex pool and consequently influence the magnitude of scour. As the interior angle becomes more acute, less channel incision occurs at the side slopes and more scour occurs within the vortex pool. Chevron-shaped weirs are typically used in river restoration work to deflect and concentrate flow toward the center of the channel downstream of the weir, thus reducing potential bank scour and providing some level of local bank protection. Natural scouring tends to occur within the vortex of the weirs where velocities and turbulence are greatest. The development of the scour holes would be self-regulating and would be limited by the backwater effects of the subsequent downstream weirs. Channel incision would not be a concern, since riprap would be provided at the side slopes of the channel, and the weirs would be anchored into the opposing embankments above the water surface elevation at maximum design flow (2,200 cfs).

Riprap would be sized based upon velocity and debris impact according to hydraulic analysis results as recommended in the USACOE's publication EM 1110-2-1601. Conservative values would be applied since larger stones are less prone to result in design error than stones that are too small. In addition, the armoring course would be underlayed with a geotextile to prevent hydrostatic uplift pressure, migration of fines, and subsequent erosion. Riprap sizing and material gradation for side slope revetments would be based upon flow velocity and would not require a factor of safety to account for debris impact due to the proposed trash racks upstream. Layer thickness of revetments would be determined by the following: one times d_{100} or one and one-half times d_{50}, whichever is greater.

The vertical profile of the weir stones provides a constant upward slope from the centerline outward to concentrate flows toward the center of the bypass channel. A 10 percent to 20 percent slope is typical. The vee-shape profile would provide greater depth for fish passage at low flows and would aid in maintaining desired velocity field distribution offering high centerline but low margin velocities.

In addition to the bypass channel, a headworks structure is required to regulate flow through the system (Drawing Alt-4A). The reinforced concrete headworks structure would be constructed adjacent to the eastern dam abutment and includes a series of fish-negotiable trash racks, slide gates equipped with hydraulic actuators, and control instrumentation to perform flow proportioning. Approximately eight 6-foot by 6-foot slide gates would be required. The headworks structure would consist of a simple headwall configuration approximately 60 feet long by 18 feet high. A remote hydraulic power unit would be housed on-site within a protective control building.

The headworks structure would serve to control flow into the channel while maintaining the necessary head for diversion during low flow conditions in the Yuba River. Additionally, the structure allows the maximum design flow (2,200 cfs) to enter the channel and maintain the 10% relationship as flow increases in the Yuba River to 22,000 cfs. The intake cannot be designed as a fixed weir structure without compromising river stage at lower flows in the Yuba River when diversions are occurring. And vice-versa, the system must be designed with sufficient depth to bypass the maximum design flow of 2,200 cfs. The inlet control slide gates operate to maintain flow requirements. Alternative concept operating sequences can be investigated further to determine maximum flow in the channel to avoid reducing upstream stage to a level that adversely affects the diversion capability.

This alternative concept would be specifically tailored to encourage and assist adult migrating fish with less delay and injury impacts than the current arrangement due to greater conveyance capability and improved attraction.

Construction Considerations

Presented below are primary considerations related to construction of the proposed project:

- Access Roads – Access is required to east side of the river to perform construction of the project. Existing vehicular access is available to the construction area, however, the established roads and trails would require upgrading for use during construction. Changes to the road alignments would likely be required to facilitate ingress and egress by large trucks and trucks with trailers. Measures to control dust would be implemented during construction.

- Contractor Staging Area – A construction staging area of approximately one acre would be required throughout the course of construction for purposes of setting up a construction office (trailer), worker vehicle parking, and storage of construction equipment and materials. Electric power would be supplied to each area. The staging area would be fenced and locked with security provision. Specific areas would be designated for hazardous material storage and/or refueling operations.

- Cofferdam – A cofferdam would be required to isolate the entire area to facilitate construction of the new fishway. The cofferdam could be constructed while maintaining the ability of the districts to continue diverting water. To minimize the introduction of turbidity into the water, it is anticipated the cofferdam would be constructed following one of two approaches. One approach is to use large fabric bags filled with gravel and placed of sufficient width and length to direct the river flow to spill over the dam along the dam crest outside the area to be notched. The second approach would involve a similar alignment, however, could be constructed by "pushing out" material available locally. To the extent the deposited bed material permits, the contractor may also consider vibrating in steel sheet piles for the cofferdam on the upstream side of the dam to minimize underseepage into the work area.

- Dewatering Work Area – The work area for constructing the new fishways would need to be dewatered for preparing the foundation and placing concrete and setting the stone weirs. Water pumped from the work area would be discharged into sediment basins where water would percolate readily and prevent sediment from entering the river.

- Fishway Construction – Construction of the bypass channel would require the creation of a new channel by excavation. Spoils from the excavation would be disposed of adjacent to the excavation. Concrete would be supplied from suppliers in the area and the stones for the weirs would be available from quarries in the region. To the extent the material could be deposited along side the new bypass channel, the excavated material could be placed there. Otherwise, spoils would need to be transported off site or sold for disposal.

All areas temporarily disturbed by construction would be restored to pre-project conditions. Existing roads would be regraded and/or graveled, as appropriate, or deemed necessary for its pre-project use and future use as related to the project. Staging areas would be re-shaped and graded to prevent ponding of water, re-planted with suitable vegetation, and protected with other erosion control measures, if necessary, to prevent turbid runoff from escaping the site. Areas permanently disturbed by construction generally do not require restoration. However, permanent cut slopes would be shaped, graded, and vegetated, as appropriate, to ensure the slopes remain stable and do not allow turbid waters to escape from the site.

Engineering Requirements

Essential engineering information required to prepare final contract documents for this alternative concept includes, but is not limited to, conducting mathematical model studies of the proposed concept; gathering geotechnical data (soil and foundation conditions); performing localized field surveys reflecting current topographical conditions; acquiring as-built drawings that define composition, dimensions, and quantities of existing facilities; identifying existing utilities available at the project sites; characterizing debris and sediment transport conditions; identifying environmental mitigation measures as they relate to construction; and establishing final design criteria required by the regulatory agencies.

Cost

Minor land acquisition may be required by this alternative concept for the new facilities since the work would mostly be conducted outside the margins of the Yuba River channel. Developing an order of magnitude cost based upon gross quantity take-offs and unit prices, the cost for design and construction of this alternative concept is estimated at $2.5 million. This includes a 25% contingency; 20% for engineering, design, and mathematical model studies; 15% for construction management; and 5% for mobilization and demobilization, but does not include environmental compliance and permitting costs. The annual operations and maintenance cost is estimated at $100,000.

Limitations

Although this alternative concept has the potential to improve upstream fish passage conditions at the site, it fails to address some of the other objectives applied in this evaluation. The proposed facilities would continue to compete with plunging flow over the dam, as the alternative concept would only convey a portion of flow during high-flow events. Since the proposed alternative concept is confined to one side of the river (the side opposite of the defined river channel), upstream migrants would be forced to traverse the entire width of the tailrace pool before locating the entrance to the proposed bypass channel. Competition with flow over the 575-foot-wide ogee dam crest during high-flow events would continue to be a significant issue. During the period from September through November when adult fall-run salmon are migrating upstream, the historic daily flow is less than the fish passage facility design flow of 2,200 about 90% of the time. Whenever the flow is less than 2,200 cfs, the facility would be operated to carry all of the flow (less diversions) without any water flowing over the dam that could attract migrating adults. In late winter and spring when adult steelhead and spring-run salmon are migrating, the facility would carry all of the flow only about 30-60% of the time.

The alternative concept would force upstream migrants to exit near the crest of the dam and possibly create conditions conducive to disorientation and fall back over the dam. This would cause upstream migrants exiting the bypass channel to be captured within high, transverse velocities sweeping over the dam. Due to the close proximity of the proposed exit locations relative to the dam, reaction time for reorientation is limited, and velocity conditions and magnitudes may not be favorable during high flows.

The alternative concept is not likely to address downstream fish passage satisfactorily. Whenever flow is greater than the diversions plus the capacity of the bypass channel, water will be discharged over the dam. Consequently, injury to juvenile salmonids and kelt steelhead would continue as they pass over the dam, although this could be mitigated to a large extent with spillway gates of not more than two feet in height. It is unlikely the new bypass channel would significantly influence or attract downstream migrants as they approach the dam crest. When water is flowing over the dam, downstream passage will occur over the dam. Thus, disorientation and predation would continue to occur at the tailrace, since scour pool conditions at the base of the dam would remain unchanged.

Debris and sediment accumulation at the new headworks trash racks would result in increased maintenance. Maintenance demands would likely be exacerbated over existing conditions, as the opportunity for debris and sediment blockage would increase given the incorporation of the new headworks structure.

The low-head stone weir system may be vulnerable to excess sedimentation or scour and may require periodic in-stream maintenance to preserve the spatial limits of resting pool formation and subsequent hydraulic conditions required for fish passage. Furthermore, changing river geomorphology downstream of the bypass channel could affect the functional ability of the system following high runoff events and require repair and/or modification to maintain effective channel entrance conditions.

Benefits

This alternative concept is a commonly used fish passage alternative for natural stream channel renovation and improvement. In addition, a number of former projects could be used as design examples to confirm performance for this particular application. This alternative concept is capable of accommodating the entire fishway design flow of 2,200 cfs within a single, consolidated fish passage facility. The bypass channel has the potential for improving upstream fish passage by increasing attraction flow. Furthermore, this alternative concept would provide a supplemental passage route in addition to those offered by the existing fish ladders. This alternative concept also provides more natural channel conditions for fish passage than a fish ladder. The increase in fish passage flow and the provision of an additional passage route would have a positive affect on upstream migrant passage efficiency, however, under high flows the benefits of this concept are diminished.

Another advantage to upstream migrants is that illegal harvesting would likely be no easier within the bypass channel than in the natural river. This alternative concept may benefit downstream fish passage during low flow conditions by increasing attraction currents at the inlet of the bypass channel, thus improving discovery potential toward a safer passage route.

With respect to upstream surface water diversion capabilities, this alternative concept should be able to be designed to allow gravity diversion upstream of the dam to continue. The existing diversions and fish screen facilities would not be rendered inoperable or obsolete by this alternative concept. Additionally, the sediment impounded upstream of the dam would not be disturbed and would remain in-place upstream of the dam.

Additional benefits from this alternative concept are minimizing disturbing habitat and fisheries during construction, resilience to flood damage due to its location, minimizing disturbing impounded bed material, and minimizing operational demands. Access for maintenance activities would not be difficult and isolation of the channel could be performed at the operator's discretion. Construction would not require demolition of the existing fish ladders or dam.

Summary

The short reach bypass channel alternative concept offers some potential to improve upstream fish passage but would not satisfy all fish passage concerns. The lower part of the channel and entrance may require maintenance and repair work following major storm events for effective entrance conditions. The proposed site is opposite of the defined river channel causing upstream migrants to traverse the entire river width before gaining access to the channel entrance. Given the topography and existing facilities at the west side of the dam, it would be extremely difficult to construct this alternative concept at that location. This alternative concept would not resolve issues related to injury from passage or attempted passage over the dam without the inclusion of spillway gates, predation, and operational reliability due to debris and sedimentation blockage. However, this alternative concept would keep upstream surface water diverters whole and would not require disturbance of material upstream of the dam. Some operational maintenance would be required, but should not be considerable. The cost of this alternative concept represents the lower threshold for all options considered.

ALTERNATIVE NO. 4.B – NATURAL BYPASS CHANNEL LONG REACH

Introduction

Similar to alternative concept 4A, a long reach natural bypass channel has been proposed as a means of resolving fish passage problems at the Daguerre Point Dam. This alternative concept involves constructing a headworks control structure and a bypass channel around the east end of the dam, using a mild slope, engineered channel. The proposed bypass channel would be horizontally aligned so the downstream end to conform to the existing tailwater pool and the headworks structure located well upstream of the dam. The channel would include grade control structures for channel stability. The conditions upstream of the dam would remain unchanged, as the dam would not be disturbed. However, this alternative concept blocks the inlets to the South Yuba-Brophy diversion facilities requiring a new diversion inlet. Conveyance for fish passage releases would be controlled by the headworks structure, which regulates flow in the bypass channel in proportion to flow in the Yuba River. A concrete floodwall or levee along the proposed channel boundary would be required to provide flood protection and to prevent uncontrolled flow entry.

Description of the Proposed Alternative Concept

The long reach bypass channel alternative concept consists of a roughened stream channel that connects the existing tailrace pool and the impoundment using a mild slope, 1,500-foot riprap-lined channel to maintain negotiable hydraulic conditions for fish passage around the dam. The bypass channel would accommodate upstream fish passage by maintaining a hydraulic gradient that results in velocities and depths of flow that are favorable to fish passage. In addition, the alignment of the channel would allow the Daguerre Point Dam to remain in-place, thereby providing surface water impoundment and sediment containment upstream.

The alignment of the channel (Drawing Alt-4B) was selected to provide a reasonable channel slope of 1.4 percent, and is designed to preserve the existing structures and facilities to the extent possible. This alternative concept provides a negotiable fishway for upstream migrants by rerouting a portion of the Yuba River (up to 2,200 cfs) through a headworks structure and around the east end of Daguerre Point Dam through an open channel. The same design approach applied to the short reach bypass channel is applied herein with the exception that weirs would not be used within the channel. Instead flow velocities and energy dissipation would be controlled by boundary roughness conditions. Boulders would be placed intermittently within the channel to provide resting opportunity and channel diversity.

The bypass channel would be constructed approximately 80 feet wide by 10 feet deep with a triangular cross section and 4H:1V side slopes. Using a design slope of 1.4 percent, the channel must be approximately 1,500 feet long. The channel would be riprap-lined to produce a high degree of boundary roughness. Applying these design parameters, the bypass channel would convey 2,200 cfs at a maximum flow depth of 8.2 feet and an average water column velocity of 8.0 feet per second. At a low flow threshold of 50 cfs, the channel would continue to maintain a passable flow depth of 2.0 feet maximum at an average velocity of 3.0 feet per second. The triangular configuration provides suitable upstream fish passage conditions throughout the design flow range. The vee-shape cross-section provides a velocity field distribution offering higher velocities along the centerline with lower velocities along the margin of the channel.

The long reach bypass channel concept would incorporate five concrete grade control structures to maintain channel stability. Large diameter boulders would be placed within the bypass channel to break up flow patterns and provide variable hydraulic conditions within the water column. The boulders would be no less than five feet in diameter. Erosion control would be provided by a full-coverage, riprap revetment. Riprap would be sized in accordance with the recommendation in the USACOE's publication EM 1110-2-1601. Conservative values should be applied since larger stones are less prone to result in design error than stones that are too small. In addition, the armoring course would be underlayed with a geotextile to prevent migration of fines and erosion. Riprap sizing and material gradation for side slope revetments would be based upon flow velocity and would not require a factor of safety to account for debris impact due to the proposed trash racks upstream. Layer thickness of revetments would be determined by the following: one times d_{100} or one and one half times d_{50}, whichever is greater.

In addition to the bypass channel, two headworks structures would be designed to regulate flow into the bypass channel and the south Yuba-Brophy diversion (Drawing Alt-4B). The reinforced concrete headworks structures would be constructed adjacent to the upstream inlet of the South Yuba-Brophy diversion. The headworks structures would include a series of fish-negotiable trash racks and slide gates equipped with hydraulic actuators and control instrumentation to perform flow proportioning. Approximately eight 6-foot by 6-foot slide gates would be required at the bypass channel headworks and six 8-foot by 8-foot gates at the diversion headworks. The headworks structures consist of a simple floodwall configuration approximately 80 feet long by 18 feet high. A remote hydraulic power unit would be housed on-site within a protective control building to control gate modulation at the headworks structures. Diversions would be conveyed underneath the bypass channel through six 8-foot-diameter conduits.

The channel headworks structure would serve to control flow into the channel while maintaining the necessary head for diversion during low flow conditions in the Yuba River. Additionally, the structure allows the maximum design flow (2,200 cfs) to enter the channel and maintain the 10% relationship as flow increases in the Yuba River to 22,000 cfs. The intake cannot be designed as a simple weir structure without compromising river stage at lower flows in the Yuba River when diversions are occurring. And vice-versa, the system must be designed with sufficient depth to bypass the maximum design flow of 2,200 cfs. The inlet control slide gates would operate to maintain flow requirements. Alternative concept operating sequences can be investigated further to determine maximum flow in the channel to avoid reducing upstream stage to a level that adversely affects the diversion capability.

The final element of this alternative concept includes a concrete floodwall/retaining wall or earthen levee to protect the bypass channel against high river flows. The protection system would tie into the existing dam abutment downstream and at high ground at the upstream end.

Construction Considerations

Presented below are primary considerations related to construction of the proposed project:

- Access Roads – Access is required to the east side of the river to perform construction of the project. Existing vehicular access is available to the construction area, however, the established roads and trails would require upgrading for use during construction. Changes to the road alignments would likely be required to facilitate ingress and egress by large trucks and trucks with trailers. Measures to control dust would be implemented during construction. Access for construction of the bypass channel would be relatively easy to provide.

- Contractor Staging Area – A construction staging area of approximately one acre would be required throughout the course of construction for purposes of setting up a construction office (trailer), worker vehicle parking, and storage of construction equipment and materials. Electric power would be supplied to each area. The staging area would be fenced and locked with security provisions. Specific areas would be designated for hazardous material storage and/or refueling operations.

- Cofferdam – A cofferdam would be required to isolate the work area for construction of the headworks structure and diversion structure as well as the upper portion of the fishway. Provision would be required to provide a temporary diversion until the diversion structure is completed. To minimize the introduction of turbidity into the water, it is anticipated the cofferdam would be constructed following one of two approaches. One approach is to use large fabric bags filled with gravel and placed of sufficient width and length to direct the river flow to spill over the dam along the dam crest outside the area to be notched. The second approach would involve a similar alignment, however, could be constructed by "pushing out" material available locally.

- Dewatering Work Area – The work area for constructing the new fishways would need to be dewatered for preparing the foundation and placing concrete and setting the stone weirs. Depending upon the composition of the foundation material along the alignment of the bypass channel, seepage from the river could be significant. If this is the case, the contractor may initiate work from the downstream end to allow the excavated channel to function as a drain during construction. Water would have to be controlled at the sites for the weirs, however the balance of the work could be performed in wet conditions. A sediment basin would need to be constructed immediately downstream of the entrance to the fishway to trap sediment that may be created from the work. Water pumped from the work area would be discharged into sediment basins where water would percolate readily and prevent sediment from entering the river.

- Fishway Construction–Construction of the fishways would be of conventional construction. Concrete would be supplied from suppliers in the area and the stones for the weirs would be available from quarries in the region.

All areas temporarily disturbed by construction would be restored to pre-project conditions. Existing roads would be regraded and/or graveled, as appropriate, or deemed necessary for its pre-project use and future use as related to the project. Staging areas would be re-shaped and graded to prevent ponding of water, re-planted with suitable vegetation, and protected with other erosion control measures, if necessary, to prevent turbid runoff from escaping the site. Areas permanently disturbed by construction generally do not require restoration. However, permanent cut slopes would be shaped, graded, and vegetated, as appropriate, to ensure the slopes remain stable and do not allow turbid waters to escape from the site.

Engineering Requirements

Essential engineering information and data required to prepare final contract documents for this alternative concept includes, but is not limited to, conducting mathematical model studies of the proposed concept; gathering geotechnical data (soil and foundation conditions); performing localized field surveys reflecting current topographical conditions; acquiring as-built drawings that define composition, dimensions, and quantities of existing facilities; identifying existing utilities available at the project sites; characterizing debris and sediment transport conditions;

identifying environmental mitigation or management measures relating to construction; and establishing final design criteria required by the regulatory agencies.

Cost

Minor land acquisition may be required by this alternative concept for the new facilities since the work would mostly be conducted outside of the margins of the Yuba River channel. Developing an order of magnitude cost based upon gross quantity take-offs and unit prices, the cost for design and construction of this alternative concept is estimated at $7.5 million. This includes a 25% contingency; 20% for engineering, design, and modeling; 15% for construction management, and 5% for mobilization and demobilization, but does not include environmental compliance and permitting costs. The annual operations and maintenance cost is estimated at $200,000.

Limitations

Although this alternative concept has the potential to improve upstream fish passage conditions at the site, it is limited by other problems associated with the existing fish ladders at Daguerre Point Dam. The proposed facilities would continue to compete with plunging flow over the dam under high-flow regimes. Since the proposed alternative concept is confined to one side of the river (the side opposite of the defined river channel), upstream migrants would need to traverse the entire length of the tailrace pool before locating the entrance to the proposed bypass channel. Competition with flow releases over the 575-foot-wide ogee dam crest would continue to be a significant issue under high flows. During the period from September through November when adult fall-run salmon are migrating upstream, the historic daily flow is less than the fish passage facility design flow of 2,200 about 90% of the time. Whenever the flow is less than 2,200 cfs, the facility would be operated to carry all of the flow (less diversions) without any water flowing over the dam that could attract migrating adults. In late winter and spring when adult steelhead and spring-run salmon are migrating, the facility would carry all of the flow only about 30-60% of the time.

This alternative concept does not adequately address downstream fish passage objectives. Since the bypass channel only redirects a fraction of the river flow (10% maximum), a large part of the flow in the Yuba River would continue to pass over the dam under conditions of high runoff. Due to the remote upstream location of the channel inlet relative to the dam, it is unlikely the new bypass channel would significantly influence or attract downstream migrants as they approach the dam crest, especially under higher river flows. Consequently, injury to juvenile salmonids and kelt steelhead would continue as they pass over the dam, although this could be mitigated to a large extent with the inclusion of spillway gates of not more than two feet in height. Downstream passage would predominantly occur over the dam. Scour pool conditions at the base of the dam would remain unchanged, and disorientation and predation would continue to occur at the tailrace.

Debris and sediment blockage at the new headworks trash racks could compromise functional reliability if unattended and would result in increased maintenance. Maintenance demands would likely be exacerbated over existing conditions, as the opportunity for debris and sediment blockage would increase given the incorporation of new headworks structures. These conditions would continue to be a recurring problem relative to river hydrology for this alternative concept.

Changing river geomorphology downstream of the bypass channel could affect the functional ability of the system over time. Since the geomorphology of the river at both ends of bypass channel would be difficult to predetermine, the final product requires continual maintenance and restoration to remain functional. An example of this issue is the Glenn-Colusa Irrigation District's diversion facility on the Sacramento River and how a changing river alignment has altered the operational capability of the diversion. Furthermore, moderate impacts to riparian habitat and disturbance of sediment would be required to implement this alternative concept.

Resilience to flood damage would also be limited to the level of floodwall protection.

Benefits

This alternative concept offers a negotiable route for fish passage as near a natural condition as can be achieved without complete dam removal. Given the relatively mild slope and conveyance capability, the long reach bypass channel would function well over a wide array of flow conditions. In addition, a number of former projects could be used as design examples to confirm performance for this particular application. The bypass channel has the potential to improve upstream fish passage by increasing attraction flow over the existing fish ladders. Furthermore, this alternative concept provides a supplemental passage route in addition to the existing fish ladders, unless removed. The increase in fish passage flow and the provision of an additional passage route would have a positive affect on upstream migrant passage efficiency. The location of the bypass channel exit is sufficiently far enough upstream of the dam to prevent disorientation and fall back. Another advantage to upstream migrants is that illegal harvesting would likely be no easier within the bypass channel than in the natural river.

From the standpoint of downstream fish passage, this alternative concept may slightly benefit downstream fish passage over existing conditions by increasing attraction currents at the inlet of the bypass channel, thus improving discovery potential toward a safer passage route.

With respect to upstream surface water diversion capabilities, this alternative concept allows Daguerre Point Dam to remain undisturbed and gravity diversion upstream of the dam to continue. The existing diversions and fish screen facilities would not be rendered inoperable or obsolete by this alternative concept.

Additional benefits of this alternative concept include minimizing disturbing fisheries during construction and minimizing operating demands. Access for maintenance activities would not be difficult and isolation of the channel could be performed at the operator's discretion. Construction would not require costly demolition of the existing fish ladders or dam.

Summary

The long reach bypass channel alternative concept offers some potential to improve upstream fish passage but would not satisfy all objectives considered in this evaluation. The location of the proposed alternative concept is not ideal due to the current geomorphology of the Yuba River immediately downstream of the dam. The proposed site is opposite the currently established river channel causing upstream migrants to traverse the entire river width before gaining access to the channel entrance. Given the topography and existing facilities at the west side of the dam, it would be extremely difficult to construct this alternative concept at that location. This alternative concept would not resolve issues related to injury from passage or attempted passage over the dam without the inclusion of spillway gates, predation, and operational reliability due to debris and sedimentation blockage. However, this alternative concept keeps upstream surface water diverters whole, but requires disturbing material upstream of the dam, which may cause movement of mercury, if present. Maintenance would be required to keep the system operational. This alternative concept provides the most natural environment for fish passage provisions of all options considered with the exception of removing the dam.

ALTERNATIVE NO. 5.A – REMOVE DAM/NEW SCREENS AND PUMP STATIONS

Introduction

Removing Daguerre Point Dam would provide the greatest improvement for fish passage in both the upstream and downstream directions. The dam would be completely demolished and removed from the river channel to return the Yuba River to its most natural state. Upstream migrants would no longer incur delay or injury. Downstream migrants would pass the modified reach without any greater risk than exists throughout the remainder of the river. This alternative concept would, however, would require removing sediment impounded upstream of the debris control dam. Furthermore, new diversion facilities would be required to maintain water supply provisions for six separate water supply entities that currently appropriate water upstream of the dam. In addition, substantial energy costs would accrue on an annual basis to operate the new facilities.

Description of the Proposed Alternative Concept

Removing Daguerre Point Dam would require blasting and demolishing the existing 575-foot-wide by 25-foot-high by 50-foot-thick ogee-type concrete debris control dam, the 575-foot- wide by 65-foot-long concrete apron, retaining walls, abutments, and the two existing fish ladders. According to the USACOE's preliminary study, this alternative concept requires additional environmental management measures as the sediment is disturbed from excavation activities, and would impact a linear reach of approximately three miles upstream. This effort would yield over four million cubic yards of material. Erosion control measures would also be required along the new embankments to ensure channel incision and excess scour does not occur at the new and vulnerable sides slopes.

The other main component of this alternative concept is the construction of new pumped diversion facilities to replace the existing diversion facilities rendered obsolete once the dam is removed. This involves constructing two new pumping plants with associated fish screen structures. The existing facilities on the west bank would be consolidated into a 750 cfs capacity plant and a new 600 cfs pumping plant would be implemented on the east bank. Additionally, increased annual operating costs would occur due to pumping.

The new, state-of-the-art, positive exclusion fish screens and bypass systems would be constructed to prevent salmonid entrainment within the diverted water. The fish screen facilities need to comply with current fish screen criteria of the NOAA and CDFG, and would consist of separate vertical, flat plate, chevron fish screen arrangements typically used for large diversion systems. Since head differential would be lost at the subject sites, bypass flows used for producing a sweeping and transport velocity component at the faces of the screens would have to be attained through integration of significant return bypass pipelines.

Construction Considerations

Presented below are primary considerations related to construction of the proposed project:

- Access Roads – Access is required to both sides of the river to perform construction of the project. Existing vehicular access is available to both sides of the river, however, the established roads and trails would require upgrading for use during construction. Changes to the road alignments would likely be required to facilitate ingress and egress by large trucks and trucks with trailers. Measures to control dust would be implemented during construction.

- Contractor(s) Staging Areas – Work would be performed on both sides of the river concurrently. Accordingly, staging areas would be required throughout the course of construction for purposes of setting up construction offices (trailers), worker vehicle parking, and storage of construction equipment and materials. Electric power would be supplied to each area. The staging area would be fenced and locked with security provisions. Specific areas would be designated for hazardous material storage and/or refueling operations.

- Cofferdam – A cofferdam would be required to isolate the work area for the first season dam removal. It is anticipated the dam removal would be initiated on the east side in the first season. To minimize the introduction of turbidity into the water, it is anticipated the cofferdam would be constructed following one of two approaches. One approach is to use large fabric bags filled with gravel and placed of sufficient width and length to direct the river flow to spill over the dam along the dam crest outside the area to be notched. The second approach would involve a similar alignment, however, could be constructed by "pushing out" material available locally. Depending upon the gradation of the bed material deposited in the vicinity of the dam, the contractor may consider vibrating steel sheet piles along the cofferdam alignment to reduce underseepage into the work area. Special attention would be required in planning the construction of the cofferdam in relation to excavation of the "geomorphic" channel. To minimize uncontrolled scour of bed material deposited upstream of the dam, excavating the channel would need to be performed concurrent with removal of the dam. As much material as possible would need to be removed in the one construction season. The deposited material, on which the cofferdam is constructed, would, for the most part, be removed by the river scouring and transporting the material through the notch during the winter period following removal of the east side of the dam.

- Dewatering Work Area – The work area for removing the dam would not have to be dry but needs to dewatered sufficiently to allow equipment to work efficiently. Water removed by pumping from the construction area would be discharged into sediment basins where water would percolate readily and prevent sediment from entering the river.
- Dam Removal – It is anticipated that a large part of the demolition work would be accomplished with explosives. Heavy equipment such as bulldozer would be used to break up structural concrete into sizes that could be loaded and removed from the work area by truck. Access to the downstream side of the dam should be readily available. This would facilitate loading and removing the concrete. It is anticipated the dam is mass concrete without reinforcing steel in which case it would be appropriate to crush the concrete and recycle it as road base or other construction material. Recycling the structural concrete from the fish ladders, abutments, and headworks would require

removal and disposal of the reinforcing steel. The crushed concrete could be used as surfacing for the roads to access the pump stations in the future.

- Temporary Water Diversions – Construction of the temporary bypass facilities would be required in the first season to be sure water deliveries could be made the following summer. Once the cofferdam is removed, the river stages would be lowered and gravity diversion would be possible through the existing facilities.

- Geomorphic Channel Excavation – Excavating the channel could be accomplished by dredging. To the extent the material could be deposited in the gold mining tailings (Yuba gold fields), the dredged material could be transported either by a slurry pipeline or a conveyor system. A fair degree of flexibility would exist in placing the material by employing either method. To minimize the amount of deposited material transported downstream when the cofferdam is removed, excavation of the channel needs to be performed during the first construction season.

- Pump Stations and Discharge Pipelines – It is proposed the pump stations would be constructed near the location of the abutments of the dam. Just how the site would respond to the changed conditions cannot be predicted with certainty. It is anticipated, therefore, that construction of the permanent pump stations would follow construction of the notch by a few years to allow time to observe the behavior of the channel and banks in advance of constructing the pump stations. A cofferdam would be constructed to isolate the pump station construction site from the active channel at the time construction is to occur. Water pumped from the construction area would be discharged to sediment basins to avoid having sediment enter the river.

  Although it may be prudent to postpone construction of the pump stations, the discharge pipelines could be constructed. Construction of the pipelines could be performed following standard construction procedures. Construction of the pipeline is not expected to create any hazards or risks.

All areas temporarily disturbed by construction would be restored to pre-project conditions. Existing roads would be regraded and/or graveled, as appropriate, or deemed necessary for its pre-project use and future use as related to the project. Staging areas would be re-shaped and graded to prevent ponding of water, re-planted with suitable vegetation, and protected with other erosion control measures, if necessary, to prevent turbid runoff from escaping the site. Areas permanently disturbed by construction generally do not require restoration. However, permanent cut slopes would be shaped, graded, and vegetated, as appropriate, to ensure the slopes remain stable and do not allow turbid waters to escape from the site.

Engineering Requirements

Essential engineering information required to prepare final contract documents for this alternative concept includes, but is not limited to, conducting significant project management and coordination; performing geomorphologic studies; gathering geotechnical data (soil and foundation conditions); performing extensive field surveys reflecting current topographical conditions; performing hydraulic and hydrologic studies; acquiring as-built drawings that define composition, dimensions, and quantities of existing facilities; identifying existing utilities available at the project sites; further characterizing debris and sediment transport conditions; identifying environmental management and/or mitigation measures relating to construction; and establishing final design criteria as required by the regulatory agencies.

Cost

Elements of the USACOE's dam removal project were utilized in preparing an order of magnitude cost for this alternative concept. The unit costs were reviewed generally and deemed reasonable, however, the quantities were accepted as presented since doing more was beyond the scope and budget for this assignment. The costs for pump diversions and fish screens were included to develop a total cost of $76 million. This amount includes USACOE's estimated construction management costs, engineering and design costs, and a 25% contingency, but does not include environmental compliance and permitting costs. The annual operations and maintenance cost, including energy costs, is estimated at $2 million.

Not included is the cost for disposing of the estimated four million cubic yards of material removed from the river, or the cost of maintaining irrigation service during removal of the dam and for a period pending construction of the pump station. Real estate and riparian habitat mitigation costs are also not included.

Limitations

Passage limitations for target species are removed by this alternative concept. Free migration is possible by anadromous fish and other non-target species. Dam removal would eliminate an artificial grade control structure at an elevation equal to the spillway crest on the Yuba River.

The facilities and associated cost for maintaining a reliable water supply during construction is problematic. Real estate requirements are unknown at this time. The construction period from dam removal to constructing new diversions is uncertain and would be influenced by hydrologic conditions in the intervening winters. The time it would take for the river to stabilize to the point where construction of the pumped diversions would be appropriate is uncertain.

Benefits

This alternative concept offers fish passage benefits to all life stages. The opportunity for predation and injury to migrating fish is eliminated. There is no fishway to clear of sediment or debris or to maintain under this alternative concept.

Summary

Removing the dam comes down to weighing the benefits to fisheries versus the cost of the solution for doing so. This dam removal alternative concept enhances fish passage. There are substantial costs to maintain water delivery capabilities during and after construction. This alternative concept impacts approximately three miles of the river channel and will result in riparian habitat and wetlands being eliminated, thereby requiring mitigation. Disposing of the sediment from the river remains to be addressed.

ALTERNATIVE NO. 5.B – REMOVE DAM/RELOCATE POINTS OF DIVERSION

Introduction

This alternative concept is identical to alternative concept No. 5.A with the exception that the existing points of diversion would be relocated approximately three miles upstream to facilitate the gravity diversion of water. Instead of using pumping plants, new fish screened gravity diversion structures and significantly large diameter pipelines or canals would be required to deliver water to the existing conveyance/distribution systems. All other aspects of this alternative concept are the same as alternative concept 5A. This alternative concept is described in greater detail in the USACOE's preliminary study.

Description of the Proposed Alternative Concept

The composition of this alternative concept is identical to alternative concept 5A, except new, state-of-the-art, positive-exclusion fish screens and bypass systems would be constructed three miles upstream of the dam and large diameter pipelines or canals would be constructed to convey surface water to the existing points of delivery.

Construction Considerations

Presented below are primary considerations related to construction of the proposed project:

- Access Roads – Access is required to both sides of the river and for a distance of about three miles upstream of the river to facilitate removing the dam and constructing new water diversion and conveyance facilities. Existing vehicular access is available to both sides of the river, however, the established roads and trails would require upgrading for use during construction. Changes to the road alignments would likely be required to facilitate ingress and egress by large trucks and trucks with trailers. Measures to control dust would be implemented during construction.

- Contractor(s) Staging Areas – Work would be performed on both sides of the river concurrently. It is anticipated the new diversion facilities would be constructed first to ensure that water diversions would not be interrupted during removal of the dam. Accordingly, staging areas of approximately one acre would be required in the vicinity of the headworks on both sides of the river. Staging areas would be required on both sides of the river in the vicinity of the dam for dam removal. Opening these sites concurrent with construction of the headworks would facilitate contractor operations throughout the course of construction for purposes of setting up construction offices (trailers), worker vehicle parking, and storage of construction equipment and materials. Electric power would be supplied to each area. The staging area would be fenced and locked with security provisions. Specific areas would be designated for hazardous material storage and/or refueling operations.

- Cofferdam – A cofferdam would be required to isolate the work area for construction of the headworks. It is anticipated the dam removal would be initiated on the east side in the first season. To minimize the introduction of turbidity into the water, it is anticipated the cofferdam would be constructed following one of two approaches. One approach is to use large fabric bags filled with gravel and placed of sufficient width and length to direct the river flow to spill over the dam along the dam crest outside the area to be notched. The second approach would involve a similar alignment, however, could be constructed by "pushing out" material available locally. As much material as possible would need to be removed in the first construction season. Removal of the dam would be initiated the second season or once the new diversion facilities were completed. Removal of the dam would likely be initiated by creating an opening in the dam to redirect and lower the river stage. This would likely occur on the west side of the dam where the fish ladder could be removed and the dam opened up with the use of explosives. With the river moved to the west side, work could commence to remove the dam on the east side with little risk to interrupting water deliveries. Cofferdams could be constructed with large fabric bags filled with gravel or by pushing out material available locally. The work area would not be required to be completely dewatered, however needs to be sufficiently dewatered to allow construction equipment to operate efficiently. A large part of the dam removal could be accomplished from working on the east side.

- Dewatering Work Area – The work area for removing the dam would not have to be dry but needs to dewatered sufficiently to allow equipment to work efficiently. Water removed by pumping from the construction area would be discharged into sediment basins where water would percolate readily and prevent sediment from entering the river.

- Dam Removal – It is anticipated that a large part of the demolition work would be accomplished with explosives. Heavy equipment such as bulldozers would be used to break up structural concrete into sizes that could be loaded and removed from the work area by trucks. Access to the downstream side of the dam should be readily available. This would facilitate loading and removing the concrete. It is anticipated the dam is mass concrete without reinforcing steel in which case it would be appropriate to crush the concrete and recycle it as road base or other construction material. Recycling the structural concrete from the fish ladders, abutments, and headworks would require removing and disposing of the reinforcing steel. The crushed concrete could be used as surfacing for the roads to access the pump stations in the future.

- Temporary Water Diversions –Temporary water diversions would not be required as the new facilities could be constructed and completed without interrupting service and be ready for water deliveries for the subsequent irrigation season.

- Geomorphic Channel Excavation – Excavating the channel could be accomplished by dredging. To the extent the material could be deposited in the gold mining tailings (Yuba gold fields), the dredged material could be transported either by a slurry pipeline or a conveyor system. A fair degree of flexibility would exist in placing the material by employing either method. To minimize the amount of deposited material transported downstream when the diversion dam is removed, excavating the channel needs to be performed during the first construction season.

All areas temporarily disturbed by construction would be restored to pre-project conditions. Existing roads would be regraded and/or graveled, as appropriate, or deemed necessary for its pre-project use and future use as related to the project. Staging areas would be re-shaped and graded to prevent ponding of water, re-planted with suitable vegetation, and protected with other erosion control measures, if necessary, to prevent turbid runoff from escaping the site. Areas permanently disturbed by construction generally do not require restoration. However, permanent cut slopes would be shaped, graded, and vegetated, as appropriate, to ensure the slopes remain stable and do not allow turbid waters to escape from the site.

Engineering Requirements

Same as alternative concept 5A.

Cost

The costs presented by the USACOE for this alternative concept were used as the basis for the order of magnitude cost. The unit costs were reviewed generally and deemed reasonable, however, the quantities were accepted as presented since doing more was beyond the scope and budget for this assignment. An order of magnitude cost is based on the USACOE's preliminary estimate, with the cost for design and construction of this alternative concept estimated at $97 million, using pipeline conveyance facilities. This amount includes the USACOE's estimated construction management costs; engineering and design; and a 25% contingency, but does not include environmental compliance and permitting costs. The cost for real estate for the conveyance facilities and for disposing of sediment removed from the river is not included. The cost for mitigating riparian habitat and wetlands is not included. The annual operation and maintenance cost associated with this alternative concept is estimated at $500,000.

Limitations

Passage limitations for target species are removed by this alternative concept. Free migration by other species non-target species. Dam removal would eliminate an artificial grade control structure on the Yuba River.

This alternative concept has limitations similar to alternative concept 5A; however, with the relocated points of diversion upstream of the influence of the dam removed, construction of the new diversion facilities should proceed with more certainty in timing.

Benefits

This alternative concept offers similar advantages as alternative concept 5A. The gravity diversion will eliminate the pumping costs. There is no fishway to clear of sediment or debris or to maintain under this alternative concept.

Summary

Removing the dam comes down to weighing the benefits to fisheries versus the cost of the solution for doing so. This dam removal alternative concept enhances fish passage, but comes with substantial costs to maintain water delivery capabilities during and after construction. This alternative concept impacts approximately three miles of the river channel and will result in riparian habitat and wetlands being eliminated, thereby requiring mitigation. Disposing of the sediment from the river remains to be addressed.

REFERENCES

1. American Concrete Institute. “Manual of Concrete Practice – ACI 207.5R-89 – Roller Compacted Mass Concrete,” 1996.

2. American Fisheries Society. “Innovations in Fish Passage Technology,” 1999.

3. Bates, Ken M.. “Fishway Design Guidelines for Pacific Salmon,” March 1992.

4. Bell, M. C. “Fisheries Handbook of Engineering Requirements and Biological Criteria,” U.S. Army Corps of Engineers, 1984.

5. California Department of Fish and Game. “California Salmonid Stream Habitat Restoration Manual,” February 1998.

6. California Department of Fish and Game. “Fish Screening Criteria,” April 1997.

7. Clay, Charles H. “Design of Fishways and Other Fish Facilities, 2nd Edition,” 1995.

8. Congress of the United States, Office of Technology Assessment. “Fish Passage Technologies: Protection at Hydropower Facilities,” September 1995.

9. Entrix, Inc. “Daguerre Pont Dam Fish Passage Improvement Project – DRAFT Planning and Coordination Report,” February 25, 2002.

10. Entrix, Inc. “Daguerre Point Fish Passage Improvement Project – Draft Alternatives Descriptions,” March 11, 2002.

11. Fripp, Jon; Fischenich, Dr. Craig; Biedenharn, Dr. David. “Low Head Stone Weirs,” for U.S. Army Corps of Engineers (no date)

12. Katapodis, Chris. “Introduction to Fishway Design,” January 1992.

13. Mefford, Brent. “Non-Salmonid Fish Passage for Small Dams,” USBR (no date).

14. Mefford, Brent; Christensen, Rick; and Glickman, Arthur. “Fish Protection and Passage Concept Study Report – Intake Diversion Dam – Yellowstone River, Montana,” USBR, January 2000.

15. Mefford, Brent and Kubitschek, Joseph. “Grand Valley Irrigation Company – Diversion Dam Fish Passage – Physical Model Study,” USBR, September 1997.

16. National Marine Fisheries Service. Southwest Region, “Fish Screening Criteria for Anadromous Salmonids,” January 1997.

17. Nordlund, Bryan. “Designing Fish Screens for Fish Protection at Water Diversions,” National Marine Fisheries Service, May 1997.

18. Orsborn, John F. and Patrick D. Powers. “Fishways – An Assessment of Their Development and Design – Part 3 of 4,” August 1985.

19. RS Means. “Heavy Construction Cost Data,” 2002.

20. Soil Conservation Service. Engineering Field Manual, “Streambank Protection,” July 1984.

21. U.S. Army Corps of Engineers. “Daguerre Point Dam – Yuba River, California – Preliminary Fish Passage Improvement Study,” August 2001.

22. U.S. Army Corps of Engineers. “Fish Passage Investigation – Daguerre Point Dam – Yuba River, California – Preliminary Draft – Hydrology and Hydraulic Design Report,” June 20, 2000.

23. U.S. Army Corps of Engineers. Hydraulic Design Criteria, Volume 2, Chart 712-1, "Stone Stability–Velocity vs. Stone Diameter," January 1977.

24. U.S. Army Corps of Engineers. "Hydraulic Design of Flood Control Channels," EM 1110-2-1601, June 1994.

25. U.S. Army Corps of Engineers. "Channel Stability for Flood Control Projects," EM 1110-2-1418, October 1994.

26. U.S. Bureau of Reclamation. "Physical Model Study of Marble Bluff Dam Cui-Ui Passage," August 1998.

APPENDIX A

DRAFT ALTERNATIVE SCREEN CRITERIA

Daguerre Point Dam Fish Passage Improvement Project
Draft Alternative Screening Criteria

Introduction

The Daguerre Point Dam Fish Passage Improvement Project (Project) intends to improve the passage of native anadromous fish at Daguerre Point Dam. Stakeholder screening is an important component to the alternatives selection process. Sixteen potential Project alternatives have been identified. The screening process will eliminate alternatives that do not meet the Project goal and objectives. The lead agencies will use the screening results to select alternatives for evaluation in the environmental review process.

This screening document uses the terms Project Site and Project Area to distinguish different areas where actions from alternative implementation might influence.

> **Project Site -** The Project Site (site) refers to each alternative's footprint and associated construction and operation phase access and easements. For most alternatives, the site is the Daguerre Point Dam, its left and right abutments, the inundation zone, and existing water supply diversion facilities.
>
> **Project Area -** The Project Area refers to the area of potential Project influence, which varies by alternative and resource issue, but generally includes the adjacent upstream and downstream reach (es) of the lower Yuba River.

Screening Criteria Categories

Six categories are used to screen Project alternatives. Each represents a topic capturing concepts, resources, or actions that an alternative can influence. Within each category are specific screening criteria that addresses specific issues relevant to the Project meeting its goal and objectives.

Screening categories:

1. Fish Passage (adult and juvenile life stages for defined species)
2. Water Supply Reliability
3. Sediment
4. Engineering Feasibility
5. Environmental Impacts
6. Cost

Ranking Scale

Each screening criterion is rated on a scale of 1 to 5. Generally, a 1 represents a negative response, 3 is neutral (similar to existing conditions), and a 5 represents a positive response. More guidance on the scale is included within each criterion.

Compilation of Results

Ranking for each criterion is totaled within each category. Since each screening category has a different number of criteria, the rankings will be averaged within the category. For example, the Fish Passage category has 5 screening criteria. The total score for all Fish Passage criteria will be divided by total number of criteria to yield a single category score. The sum of all stakeholder scores for a category will represent the total score for the category.

1. Fish Passage

Upstream passage conditions are evaluated for adult fall-, late fall-, and spring-run chinook salmon and Central Valley Steelhead relative to their respective upmigration periods. Downstream passage conditions are evaluated for all species, because similar mechanisms of injury and predation act on all outmigrating juvenile salmon and steelhead, regardless of outmigration season.

In keeping with the Project goal, any alternative that would worsen existing passage conditions will not be considered. Therefore, scores of 1 or 2 may signal a fatal flaw in an alternative. Upstream fish passage structures will be consistent with NMFS and CDFG design criteria.

Evaluation Criteria

1.1 Adult upstream passage for fall- and late fall-run chinook. (Consider August through December flows)				
1	2	3	4	5
Passage worse than existing conditions under all flows	Passage worse than existing conditions, limited by some flows	No change	Passage better than existing conditions, but limited by some flows	Passage better than existing conditions under all flows
1.2 Adult upstream passage for spring-run chinook and steelhead. (Consider January through June flows)				
1	2	3	4	5
Passage worse than existing conditions under all flows	Passage worse than existing conditions, limited by some flows	No change	Passage better than existing conditions, but limited by some flows	Passage better than existing conditions under all flows
1.3 Juvenile downstream passage for fall- and spring-run chinook and steelhead. (Injury)				
1	2	3	4	5
Highest increase in risk of injury	Moderate to high increase in risk of injury	No change	Reduced risk of injury	Minimized risk of injury
1.4 Juvenile downstream passage for fall-, late fall-, and spring-run chinook and steelhead. (Predation)				
1	2	3	4	5
Highest increase in risk of predation	Moderate to high increase in risk of predation	No change	Reduced risk of exposure to predation	Minimized risk of predation
1.5 Upstream movement of juvenile steelhead.				
1	2	3	4	5
No passage possible (existing conditions)	Minimal passage	Passage possible at some flows		Passage possible at all flows

2. Water Supply Reliability

The Water Supply Reliability category addresses the reliability of surface water diversion facilities and their maintenance and operation costs. Project objectives are to keep existing diverters whole.

Evaluation Criteria

2.1 Surface water diversion facilities.				
1	2	3	4	5
Major reduction in reliability	Reduced reliability	No change	Improved reliability	Major improvement in reliability
2.2 Operation & maintenance. (Diverters)				
1	2	3	4	5
Substantial increase in effort and cost	Increased effort and cost	Similar to present	Reduced effort and cost	Substantial reduction in effort and cost

3. Sediment

This category addresses the treatment and fate of sediment accumulated behind the Daguerre Point Dam.

Evaluation Criteria

3.1 Release of contaminants.				
1	2	3	4	5
Disturbance where measures to prevent release are not employed		Disturbance that incorporate measures to prevent release		No disturbance

3.2 Channel capacity. (Downstream)				
1	2	3	4	5
Major decrease in channel capacity	Decrease in channel capacity	No change	Increase in channel capacity	Major increase in channel capacity

3.3 Water quality. (Turbidity/suspended sediment)				
1	2	3	4	5
Decrease that will effect sensitive resource(s) (long-term)	Minor decrease that will not effect sensitive resource(s) (short-term)	No change	Minor improvement	Measurable improvement

4. Engineering Feasibility

This category addresses issues associated with engineering design, technology, equipment, and skills needed for constructing an alternative.

Evaluation Criteria

4.1 Engineering design				
1	2	3	4	5
Unique or unproven design or features needed for the majority of facility		Some unique design required for less than 25% of facility		No unique design required
4.2 Construction				
1	2	3	4	5
Unique or unproven techniques; specialized equipment and skills		Proven techniques; regionally available equipment and skills		Standard techniques; locally available equipment and skills

5. Environmental Factors

This category serves as a preliminary scoping of some CEQA/NEPA resource issues. Here, the potential issues are organized into short-term and long-term mechanisms. Short-term mechanisms are typically associated with the construction phase of the Project. Long-term mechanisms are associated with the 'operation' phase of the Project and begin after construction is complete.

Evaluation Criteria

Short-term (Construction Phase)

5.1 Extent of land disturbance.				
1	2	3	4	5
Large new area disturbed	Minor new area disturbed	Use existing access routes, roads, staging, and footprint(s)		No land disturbance
5.2 Duration of instream activities. (Maximum allowable season is from May to October.)				
1	2	3	4	5
Need more than 2 yrs; longer than 8 months total	June through September for 2 years	June through September of 1 year	July through August of 1 year	No instream disturbance
5.3 Extent of instream work.				
1	2	3	4	5
Unable to isolate work area from flow	Isolate work area from flow	Small work area isolated from flow	Can work in naturally dry channel	No instream footprints
5.4 Total construction period.				
1	2	3	4	5
> 5 years	2 - 5 years	1 - 2 years	< 1 year	No construction required

Environmental Factors

Long-term (Operation Phase)

5.5 Riparian habitat.				
1	2	3	4	5
Net decrease of riparian habitat		No net change		Net increase in riparian habitat
5.6 Upland habitat.				
1	2	3	4	5
Net decrease in upland habitat		No net change		Net increase in upland habitat
5.7 Flow-based aquatic habitat.				
1	2	3	4	5
Net decrease in aquatic habitat		No net change		Net increase in aquatic habitat
5.8 Wildlife. (Dependent on potential change in riparian and upland habitats)				
1	2	3	4	5
Net decrease in wildlife habitat		Not net change		Net increase in wildlife habitat
5.9 Other potential Listed Species. (such as fairy shrimp, CA red-legged frog, valley elderberry long-horn beetle, Swainson's hawk, green sturgeon)				
1	2	3	4	5
Net decrease in potential ES habitat		No net change		Net increase in potential ES habitat
5.10 Cultural Resource (s). (Historic)				
1	2	3	4	5
Major loss of significant resource(s)	Loss of non-significant resource(s)	No impact	Increase knowledge	Increase knowledge and gain interpretive opportunity
5.11 Localized erosion/scour at Project Site.				
1	2	3	4	5
Substantially reduce streambed and bank stability		No change		Improved streambed and bank stability

Environmental Factors

Long-term (Operation Phase) (cont.)

5.12 Erosion/scour in Project Area.				
1	2	3	4	5
Substantially reduce streambed and bank stability		No change		Improved streambed and bank stability
5.13 Flood flows. (downstream)				
1	2	3	4	5
Increase in frequent and extreme flood elevations	Increase in flood elevations	No change		Reduction in flood elevation
5.14 Water quality. (temperature)				
1	2	3	4	5
Decrease that will effect sensitive resource(s)	Minor decrease that will not effect sensitive resource(s)	No change	Minor improvement	Measurable improvement
5.15 Local groundwater table elevations.				
1	2	3	4	5
Substantial decrease to groundwater table elevations	Slight decrease to groundwater table elevations	No change	Slight increase to groundwater table elevations	Substantial increase to groundwater table elevations

6. Cost

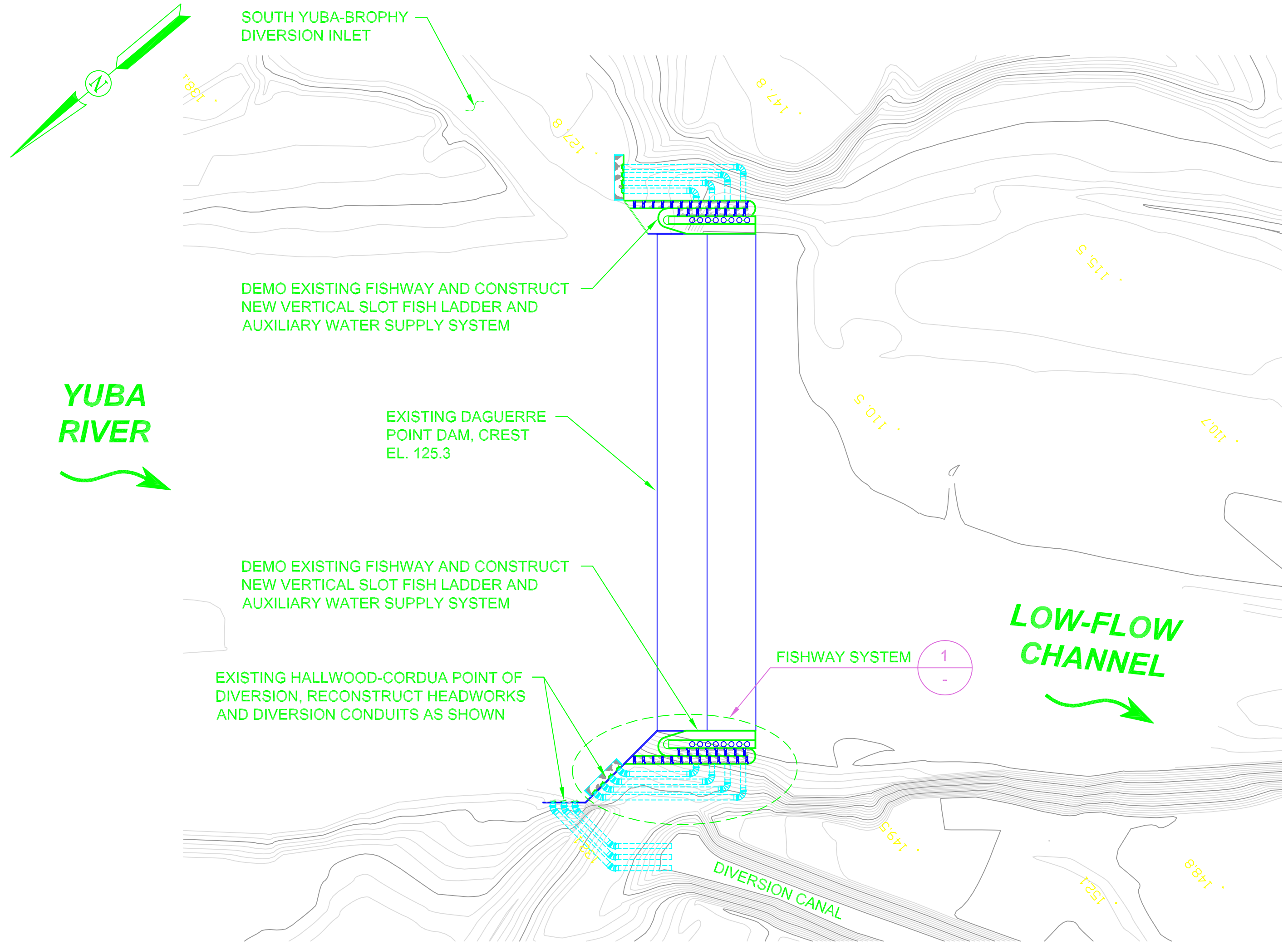
These criteria address capital outlay, need for additional land, and long term operation & maintenance costs for an alternative.

Evaluation Criteria

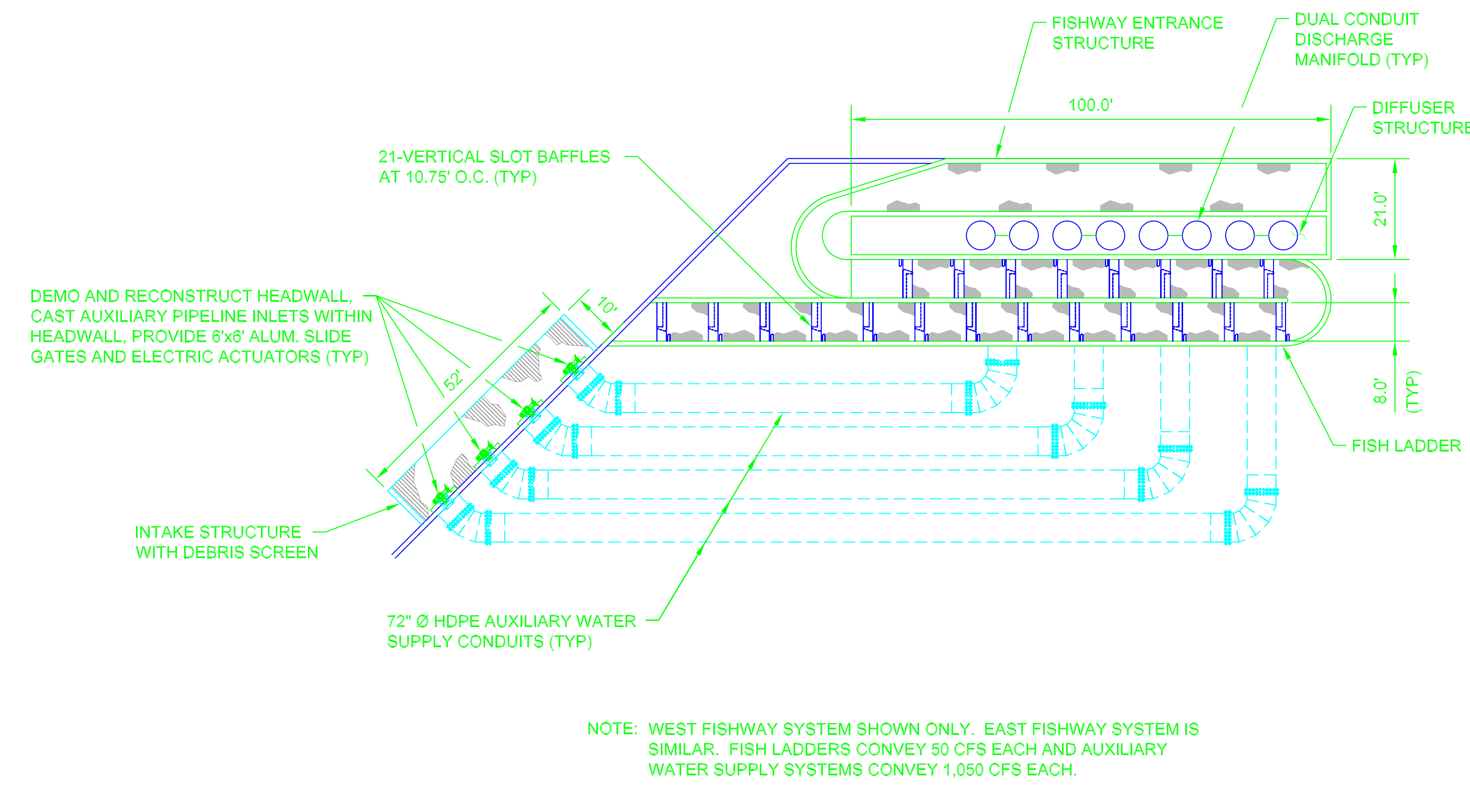
6.1 Construction cost.				
1	2	3	4	5
High		Medium		Low
6.2 Land acquisition.				
1	2	3	4	5
Complex/ expensive acquisition(s)		Easements; no land acquisition needed		No easement or land acquisition needed
6.3 Operation & maintenance. (USACOE & DWR)				
1	2	3	4	5
Substantial increase in effort and cost	Increase in effort and cost	Similar to present	Reduction in effort and cost	Substantial reduction in effort and cost

APPENDIX B

DRAWINGS OF ALTERNATIVES

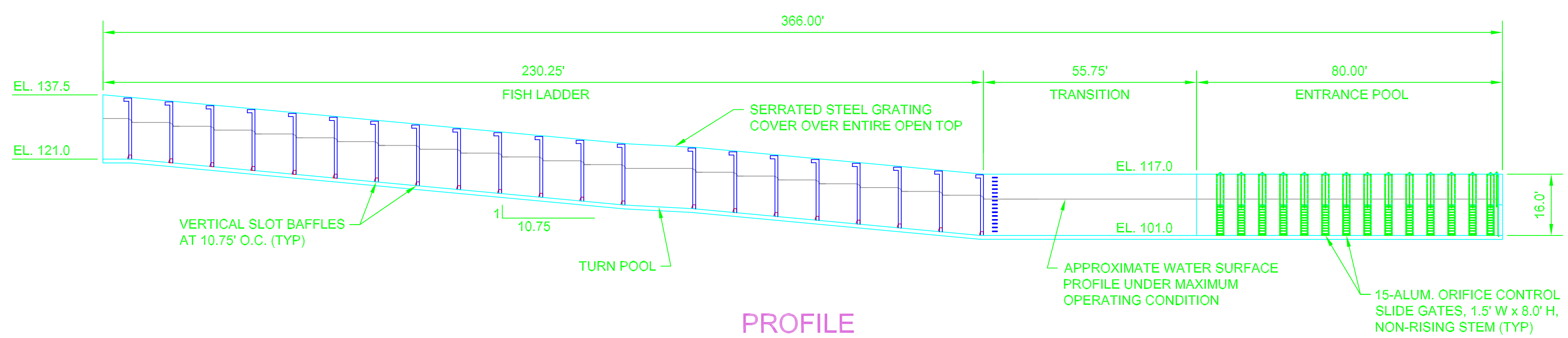


PLAN
SCALE: 1"=100'



NOTE: WEST FISHWAY SYSTEM SHOWN ONLY. EAST FISHWAY SYSTEM IS SIMILAR. FISH LADDERS CONVEY 50 CFS EACH AND AUXILIARY WATER SUPPLY SYSTEMS CONVEY 1,050 CFS EACH.

PARTIAL PLAN
SCALE: 1"=20'



PROFILE
SCALE: 1"=20'

NOTES:

1. TOPOGRAPHY PROVIDED BY USCOE FROM 1999 SURVEY FOR PRELIMINARY DRAFT HYDROLOGY AND HYDRAULIC DESIGN REPORT ISSUED JUNE 20, 2000.
2. LOCATIONS AND DIMENSIONS OF EXISTING STRUCTURES ARE APPROXIMATE.

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	8/11/02	TWB	FEB	FEB	PRELIMINARY						

DESIGNED BY: T. BULLER
DRAWN BY: T. BULLER
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 8/11/02

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St. Bldg. 100-B Sacramento, CA 95816 Tel 916.341.7760 Fax 916.341.7767

SUBMITTED

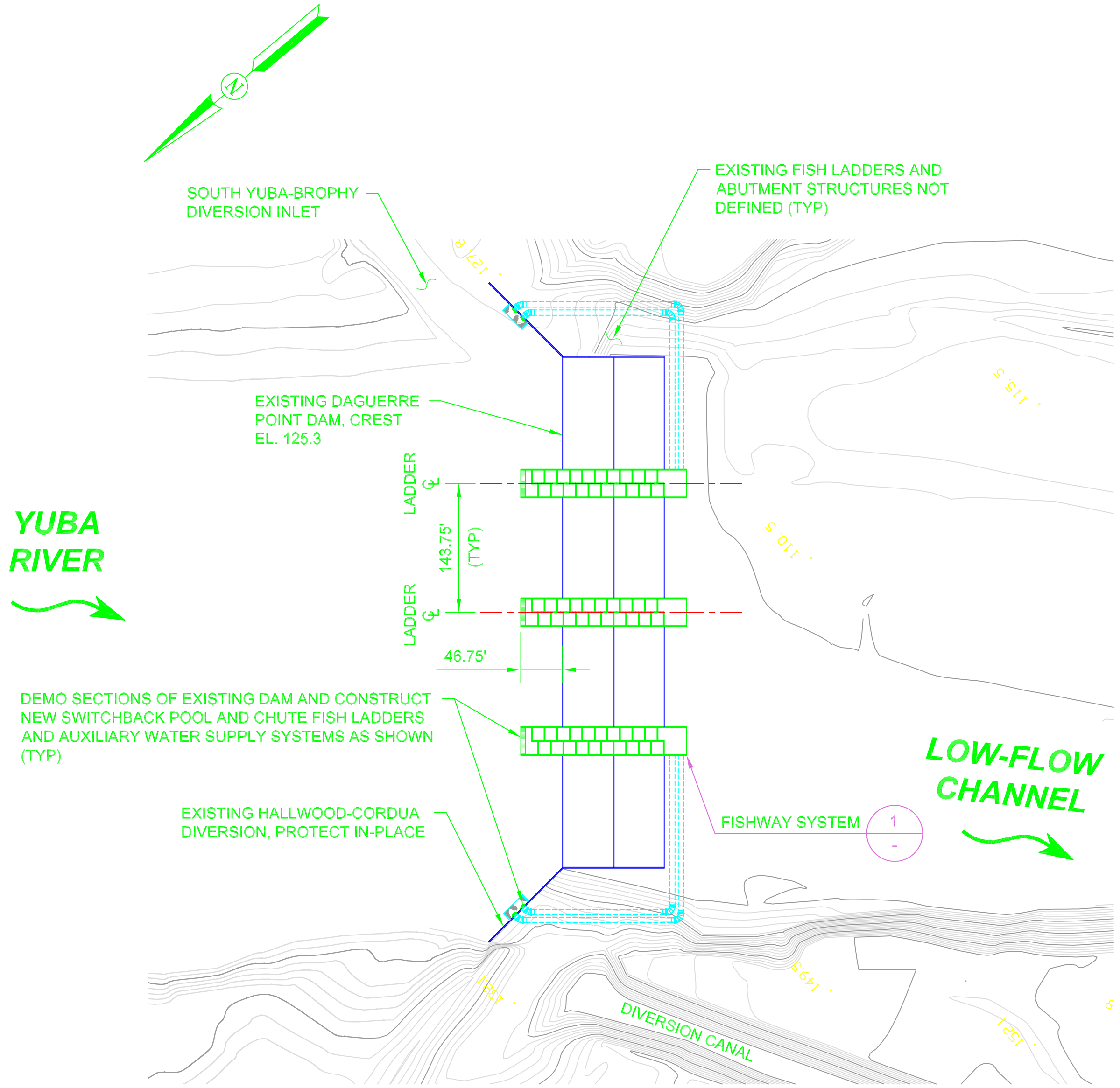
APPROVED

DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE 2A
NEW FISHWAYS AT EXISTING LOCATIONS
PLAN, PARTIAL PLAN, AND PROFILE

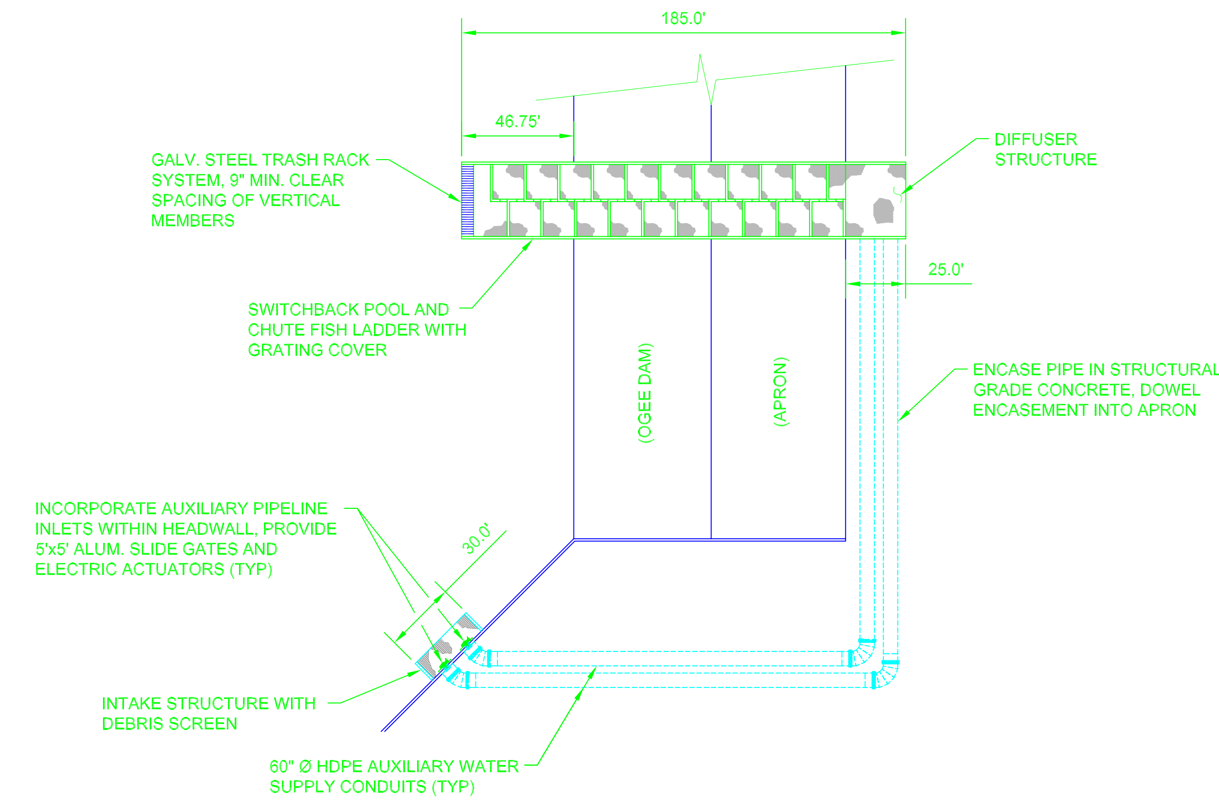
SCALE OF ORIGINAL: AS SHOWN
DRAWING NO.: ALT-2A
SHEET: 1

I:\ENGDOCS\PROJECTS\2228-Daguerre Dam\AutoCAD\Alt-2A.dwg



PLAN

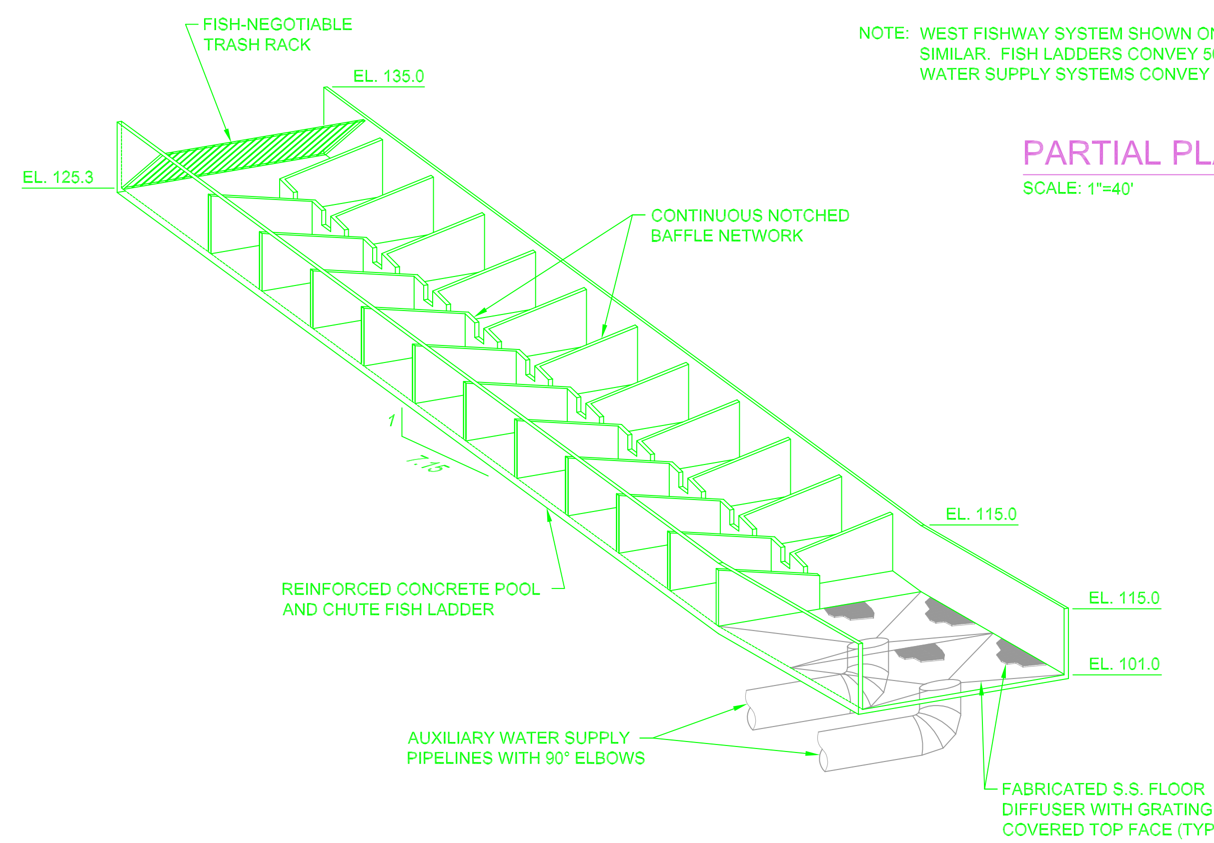
SCALE: 1"=100'



NOTE: WEST FISHWAY SYSTEM SHOWN ONLY. EAST FISHWAY SYSTEM IS SIMILAR. FISH LADDERS CONVEY 500 CFS EACH AND AUXILIARY WATER SUPPLY SYSTEMS CONVEY 350 CFS EACH.

PARTIAL PLAN

SCALE: 1"=40'



ISOMETRIC VIEW OF FISHWAY

SCALE: N.T.S.

NOTES:

1. TOPOGRAPHY PROVIDED BY USCOE FROM 1999 SURVEY FOR PRELIMINARY DRAFT HYDROLOGY AND HYDRAULIC DESIGN REPORT ISSUED JUNE 20, 2000.
2. LOCATIONS AND DIMENSIONS OF EXISTING STRUCTURES ARE APPROXIMATE.

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	8/11/02	TWB	FEB	FEB	PRELIMINARY						

DESIGNED BY: T. BULLER
DRAWN BY: T. BULLER
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 8/11/02

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St. Bldg. 100-B Sacramento, CA 95816 Tel 916.341.7760 Fax 916.341.7767

SUBMITTED

APPROVED

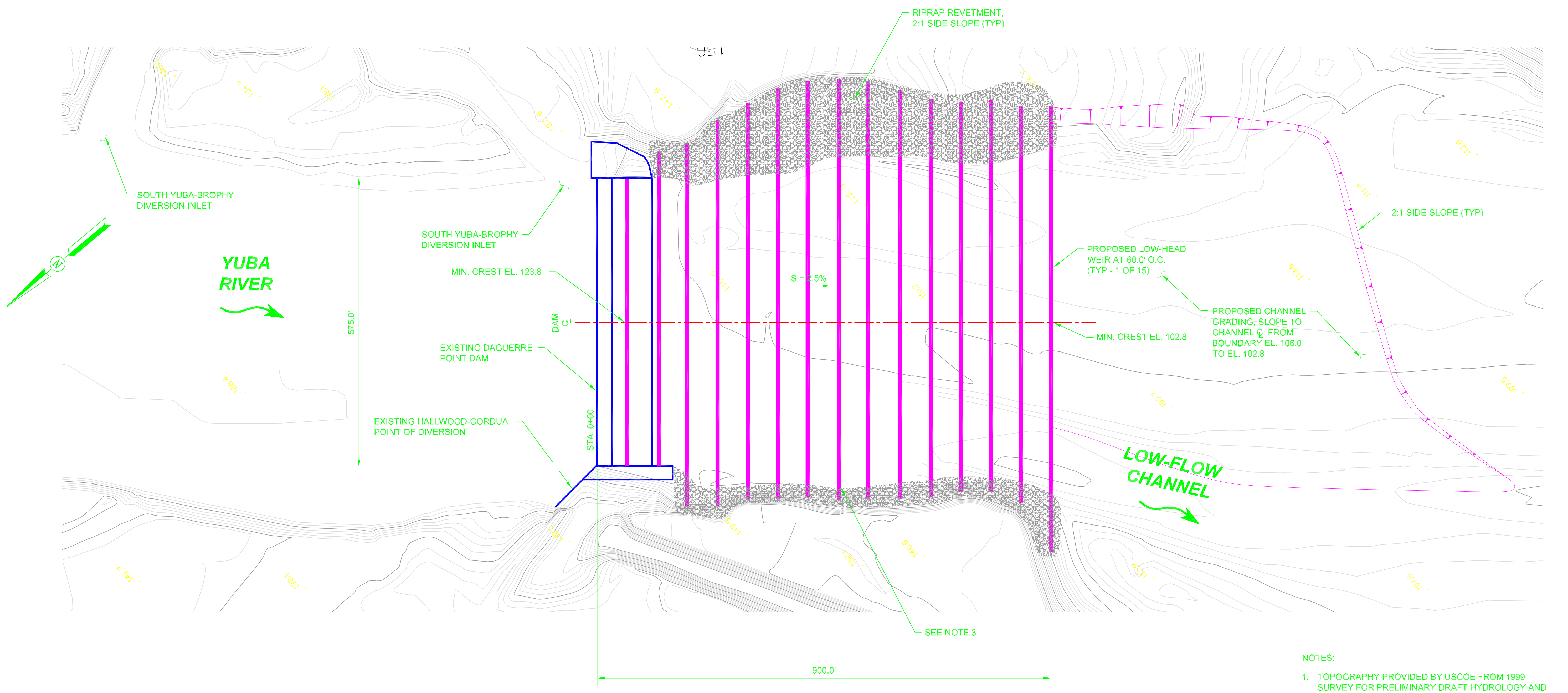
DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE 2B1
NEW FISHWAYS AT NEW LOCATIONS
PLAN, PARTIAL PLAN, AND ISOMETRIC

SCALE OF ORIGINAL: AS SHOWN

DRAWING NO.: ALT-2B1

SHEET: 1



PLAN

SCALE: 1"=100'

NOTES:

1. TOPOGRAPHY PROVIDED BY USCOE FROM 1999 SURVEY FOR PRELIMINARY DRAFT HYDROLOGY AND HYDRAULIC DESIGN REPORT ISSUED JUNE 20, 2000.
2. LOCATIONS AND DIMENSIONS OF EXISTING STRUCTURES ARE APPROXIMATE.
3. HORIZONTAL CONFIGURATION AND SPACING OF THE LOW-HEAD WEIRS WOULD BE DETERMINED THROUGH A PHYSICAL HYDRAULIC MODEL.

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	8/11/02	TWB	FEB	FEB	PRELIMINARY						

DESIGNED BY: T. BULLER
DRAWN BY: T. BULLER
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 8/11/02

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St. Bldg. 100-B Tel 916.341.7760
Sacramento, CA 95816 Fax 916.341.7767

SUBMITTED

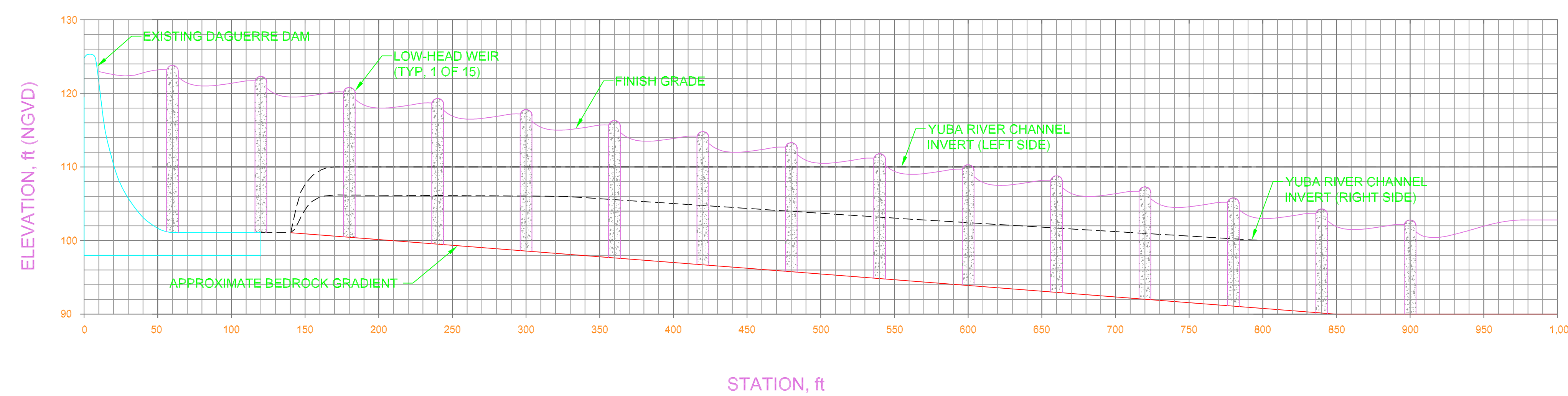
APPROVED

DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE 2B2
LOW-HEAD WEIRS DOWNSTREAM OF DAM
PLAN

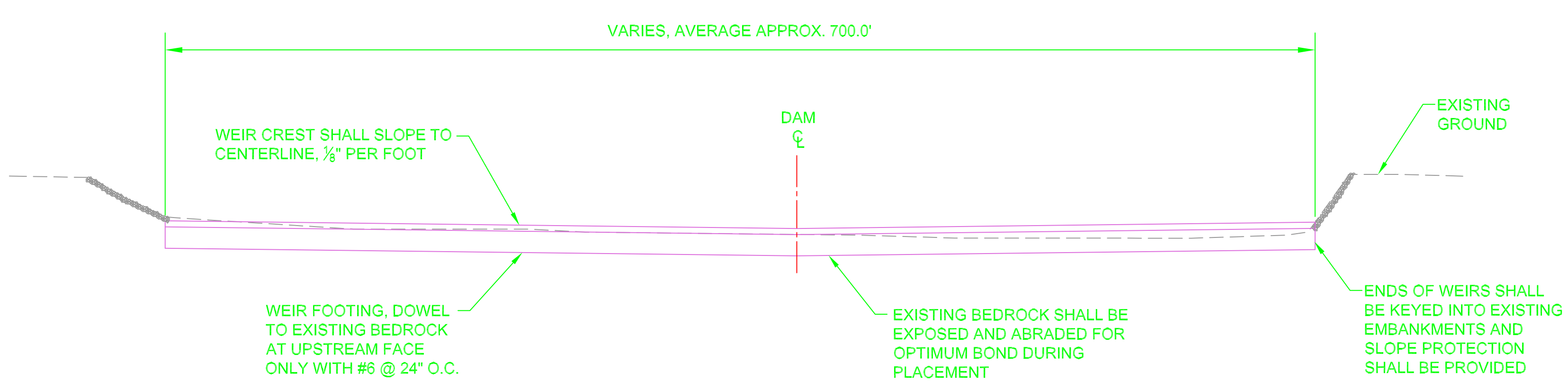
SCALE OF ORIGINAL: 1" = 100'

DRAWING NO.: ALT-2B2 SHEET: 1



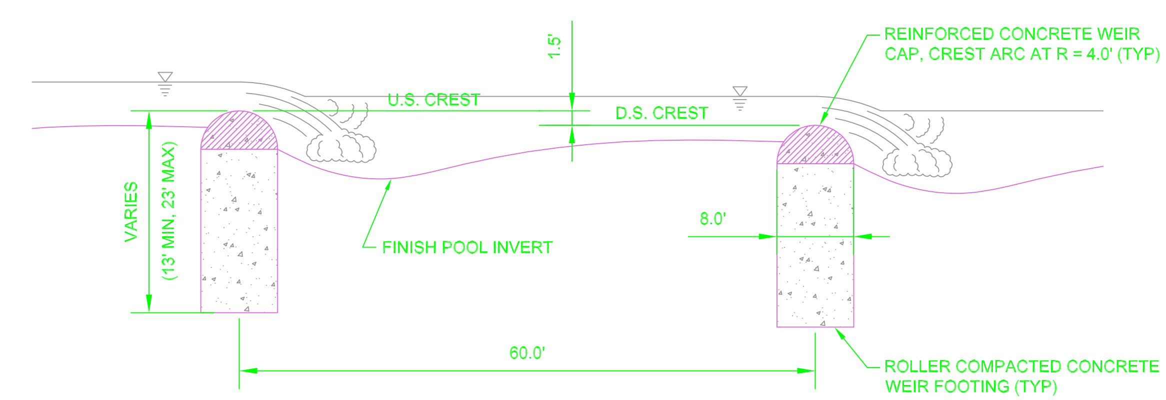
WEIR SYSTEM PROFILE

HORIZ. SCALE: 1"=50'
VERT. SCALE: 1"=10'



TYPICAL WEIR ELEVATION

SCALE: 1" = 60'



PARTIAL PROFILE

SCALE: 1" = 10'

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	8/11/02	TWB	FEB	FEB	PRELIMINARY						

DESIGNED BY: T. BULLER
DRAWN BY: T. BULLER
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 8/11/02

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St, Bldg. 100-B Sacramento, CA 95816 Tel 916.341.7760 Fax 916.341.7767

SUBMITTED

APPROVED

DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

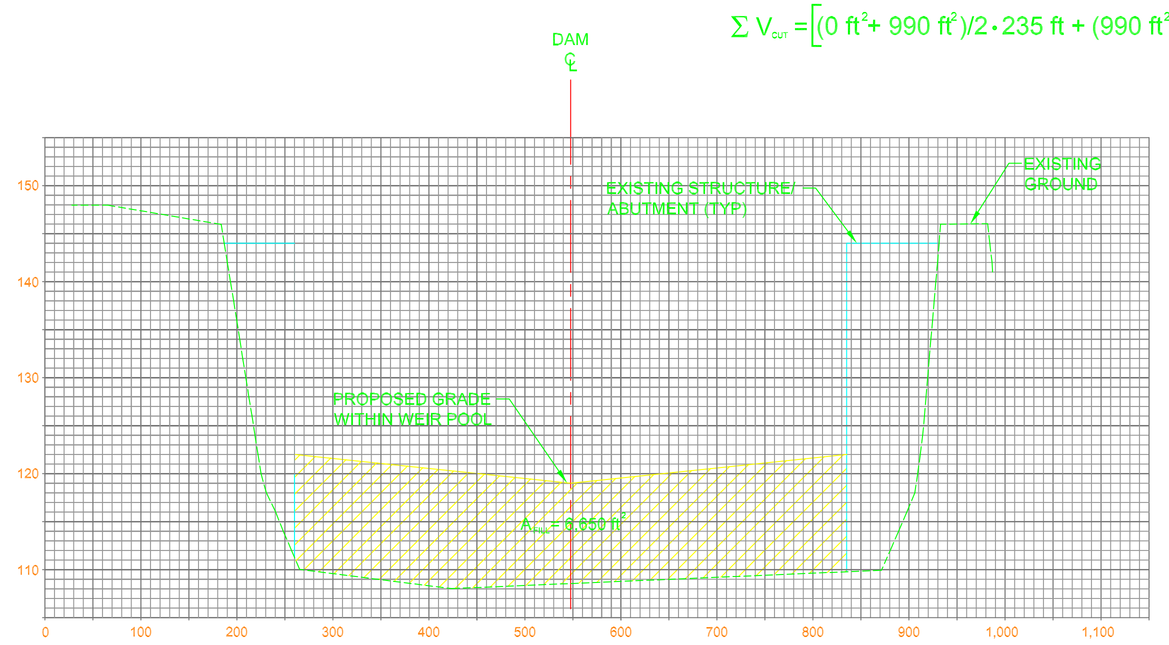
ALTERNATIVE 2B2
LOW-HEAD WEIRS DOWNSTREAM OF DAM
PROFILES AND ELEVATION

SCALE OF ORIGINAL: AS SHOWN

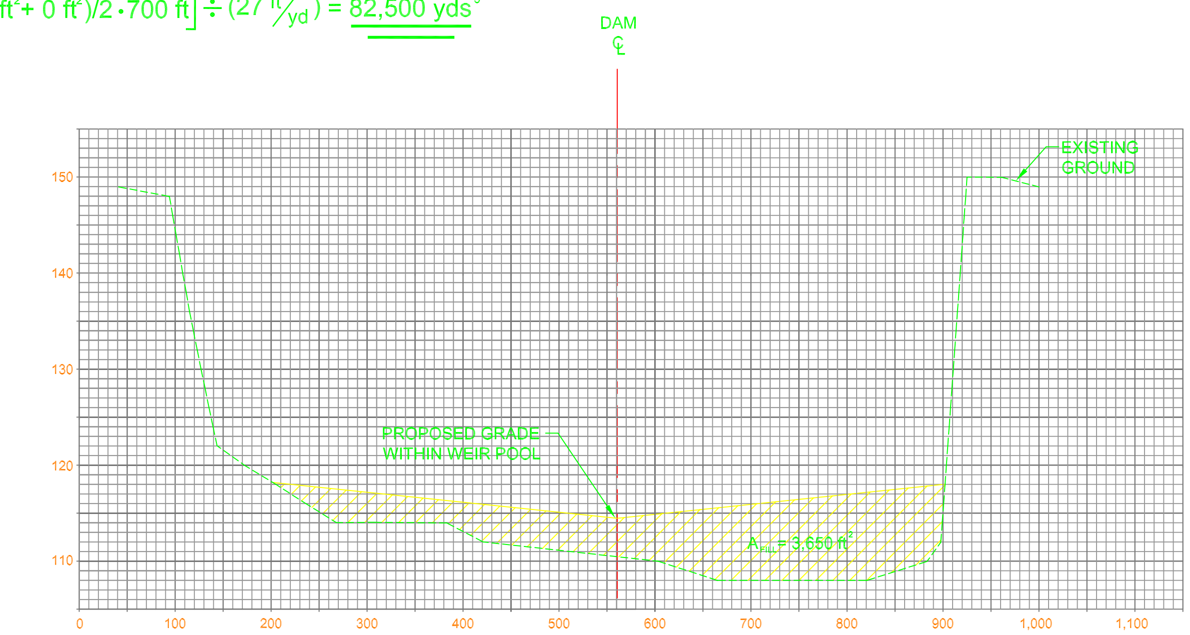
DRAWING NO. ALT-2B2 | SHEET 2

$$\Sigma V_{FILL} = \left[(0\ ft^2 + 6{,}650\ ft^2)/2 \cdot 125\ ft + (6{,}650\ ft^2 + 3{,}650\ ft^2)/2 \cdot 175\ ft + (3{,}650\ ft^2 + 1{,}320\ ft^2)/2 \cdot 235\ ft + (1{,}320\ ft^2 + 475\ ft^2)/2 \cdot 245\ ft + (475\ ft^2 + 0\ ft^2)/2 \cdot 700\ ft\right] \div (27\ ft^3/yd) = \underline{84{,}700\ yds^3}$$

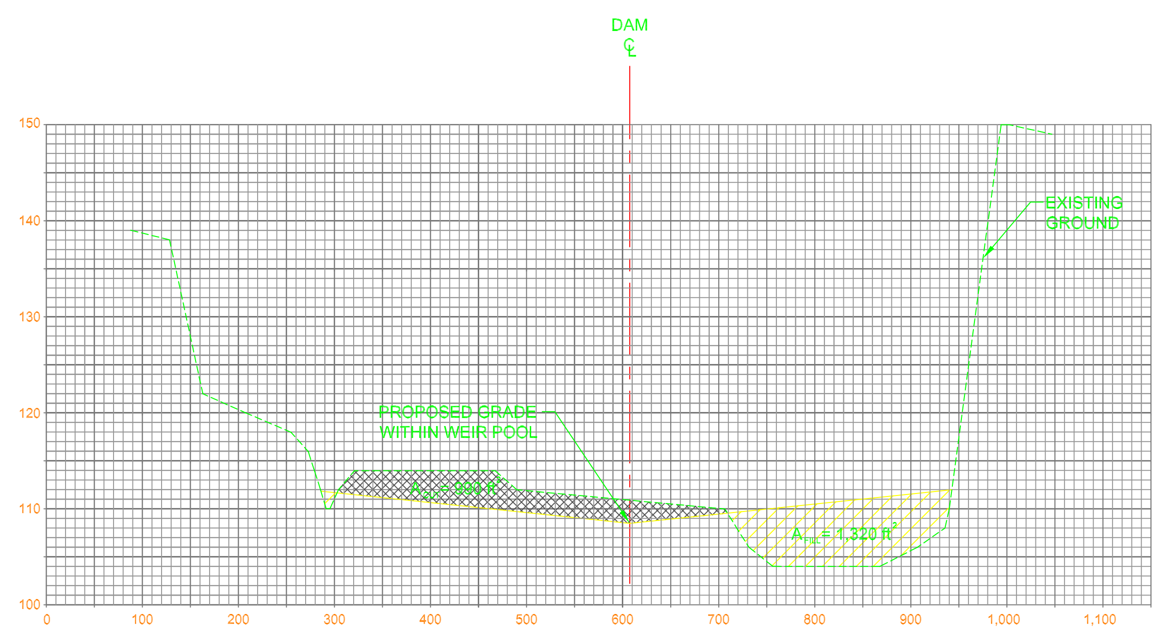
$$\Sigma V_{CUT} = \left[(0\ ft^2 + 990\ ft^2)/2 \cdot 235\ ft + (990\ ft^2 + 4{,}210\ ft^2)/2 \cdot 245\ ft + (4{,}210\ ft^2 + 0\ ft^2)/2 \cdot 700\ ft\right] \div (27\ ft^3/yd) = \underline{82{,}500\ yds^3}$$



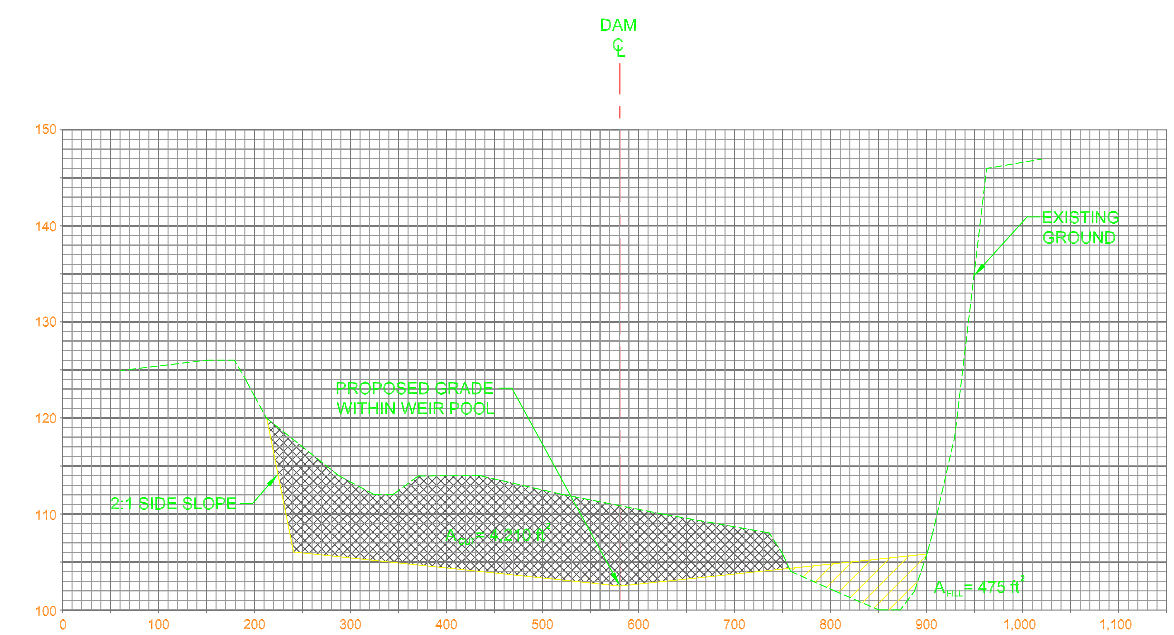
SECTION A 2B2-1
STA. 1+50



SECTION B 2B2-1
STA. 3+25



SECTION C 2B2-1
STA. 5+60



SECTION D 2B2-1
STA. 8+05

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	8/11/02	TWB	FEB	FEB	PRELIMINARY						

DESIGNED BY: T. BULLER
DRAWN BY: T. BULLER
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 8/11/02

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St, Bldg. 100-B Sacramento, CA 95816 Tel 916.341.7760 Fax 916.341.7767

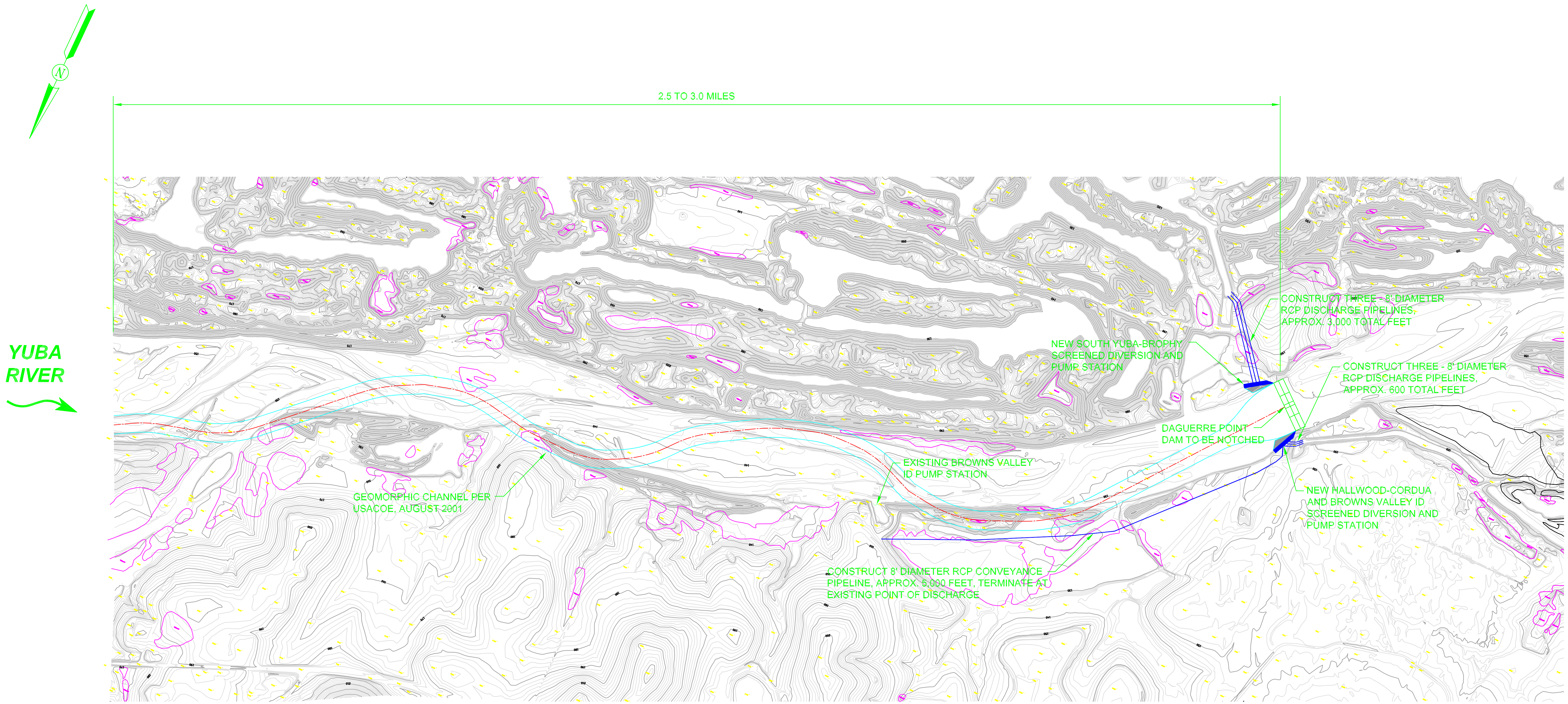
SUBMITTED
APPROVED

DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE 2B2
LOW-HEAD WEIRS DOWNSTREAM OF DAM
CROSS-SECTIONS

SCALE OF ORIGINAL
HORIZ. 1" = 100'
VERT. 1"=10'

DRAWING NO. ALT-2B2
SHEET 3



NOTE: EXISTING FISHWAYS, ABUTMENTS, AND DAM STRUCTURES TO REMAIN. CHANNEL TO BE EXCAVATED.

NOTES:

1. TOPOGRAPHY PROVIDED BY USACOE FROM 1999 SURVEY FOR PRELIMINARY DRAFT HYDROLOGY AND HYDRAULIC DESIGN REPORT ISSUED JUNE 20, 2000.
2. LOCATIONS AND DIMENSIONS OF EXISTING STRUCTURES ARE APPROXIMATE.

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	9/4/03	JPP	FEB	FEB	PRELIMINARY						

DESIGNED BY: J. PRITCHARD
DRAWN BY: J. PRITCHARD
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 9/4/03

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St, Bldg. 100-B Sacramento, CA 95816 Tel 916.341.7760 Fax 916.341.7767

SUBMITTED

APPROVED

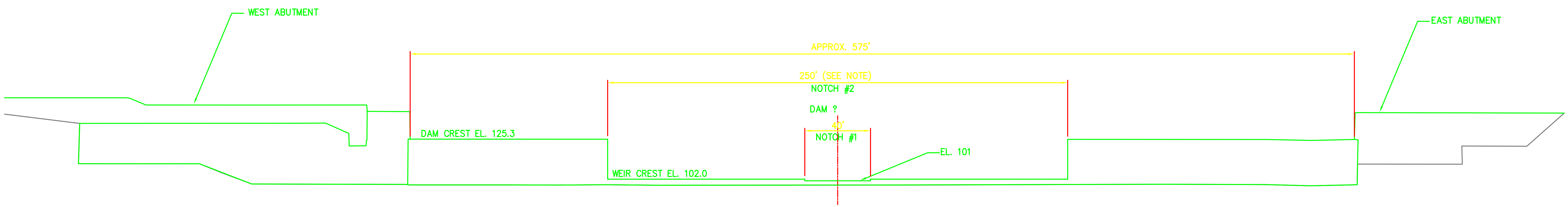
DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE 3
NOTCH DAM TO PASSABLE HEIGHT
PLAN

SCALE OF ORIGINAL: 1" = 600'

DRAWING NO.: ALT-3

SHEET: 1



ELEVATION
SCALE: 1"=30'

NOTE:
LOCATION TO BE DETERMINED WITH CONSIDERATIONS GIVEN TO CONSTRUCTION AND RIVER MORPHOLOGY.

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	9/4/03	JPP	FEB	FEB	PRELIMINARY						

DESIGNED BY: J. PRITCHARD
DRAWN BY: J. PRITCHARD
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 9/4/03

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St. Bldg. 100-B Sacramento, CA 95816 Tel 916.341.7760 Fax 916.341.7767

SUBMITTED

APPROVED

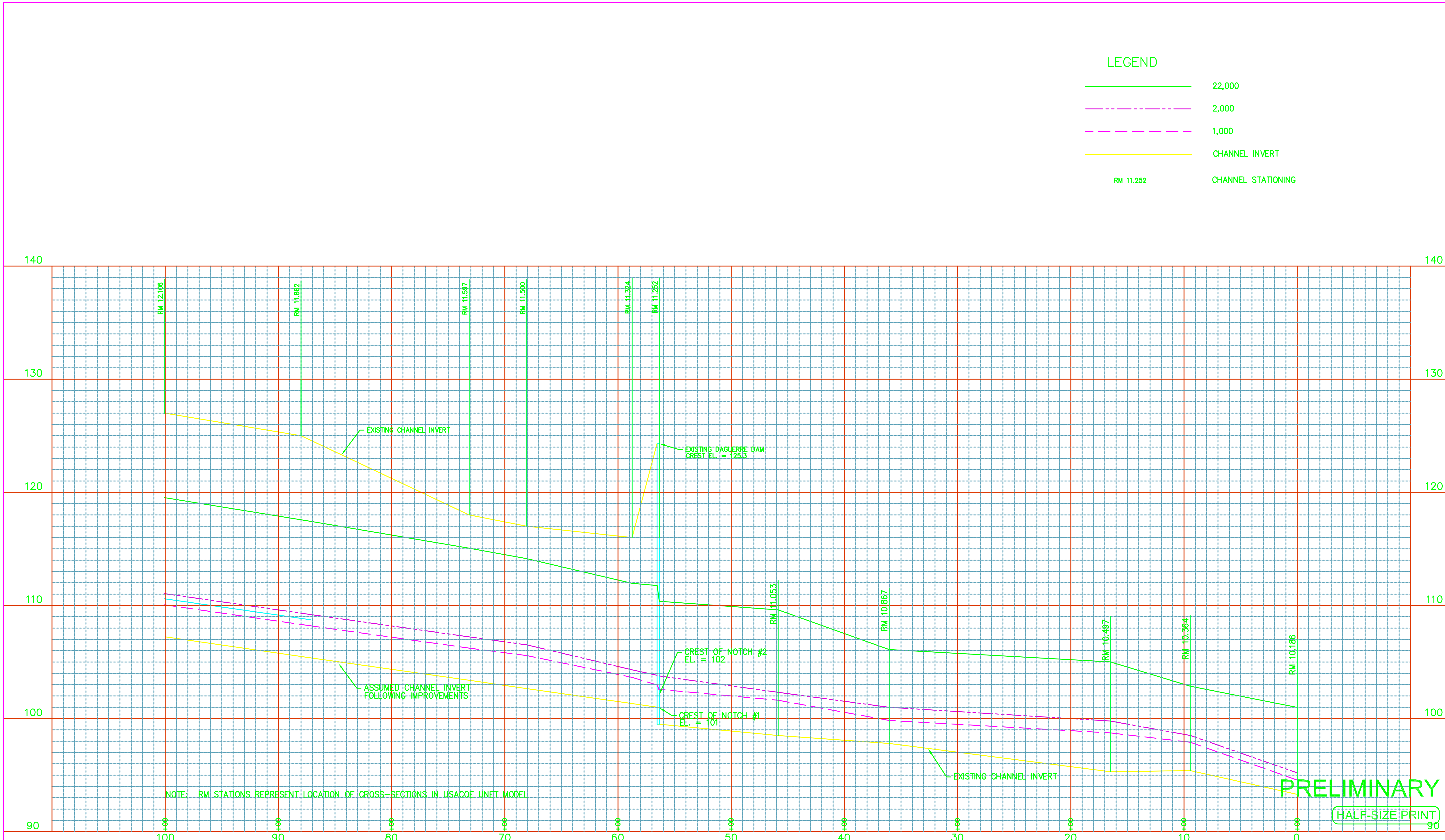
DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE 3
NOTCH DAM TO PASSABLE HEIGHT
ELEVATION

SCALE OF ORIGINAL: AS SHOWN

DRAWING NO.: ALT-3

SHEET: 2



REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	9/4/03	JPP	FEB	FEB	PRELIMINARY						

DESIGNED BY: J. PRITCHARD
DRAWN BY: J. PRITCHARD
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 8/11/02

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St. Bldg. 100-B Tel 916.341.7760
Sacramento, CA 95816 Fax 916.341.7767

SUBMITTED

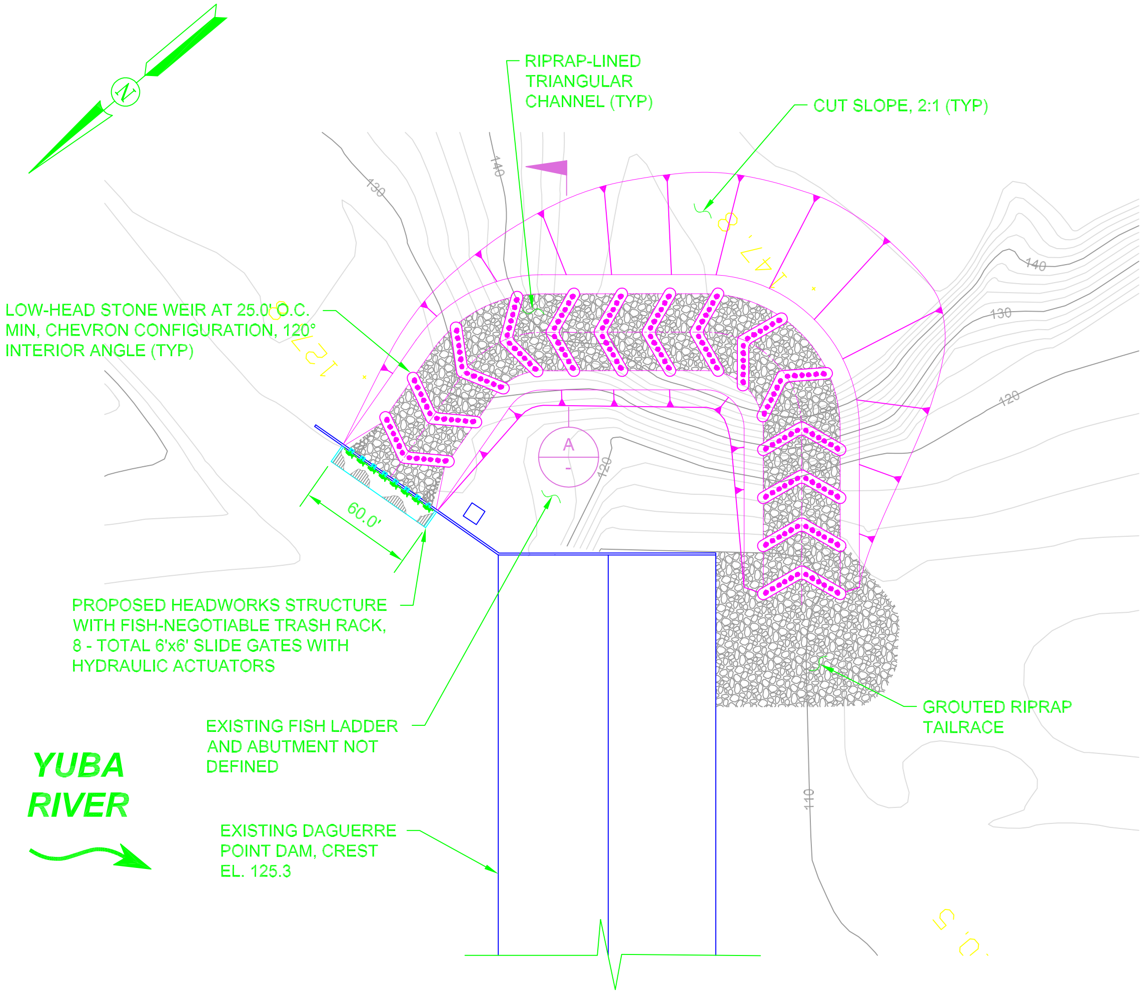
APPROVED

DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE 3
NOTCH DAM TO PASSABLE HEIGHT
PROFILE

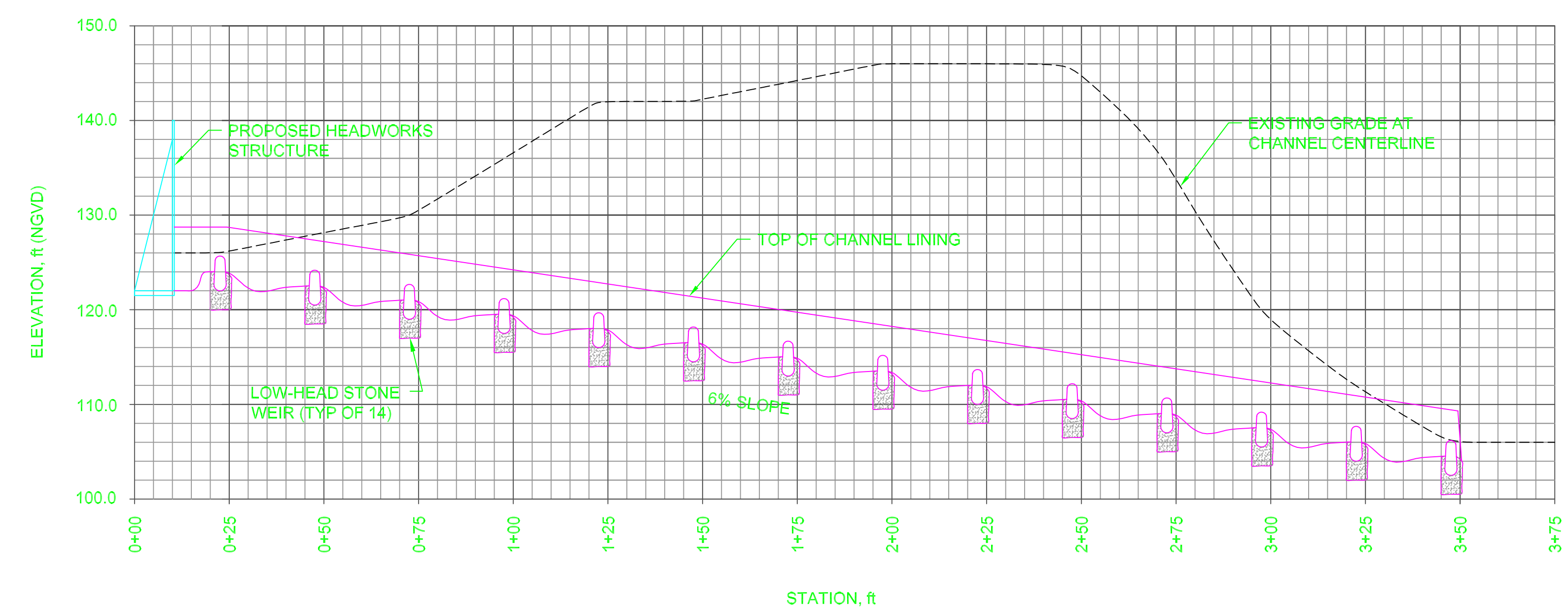
SCALE OF ORIGINAL
HORIZONTAL: 1"=400'
VERTICAL: 1"=4'

DRAWING NO. ALT-3
SHEET 3



PLAN

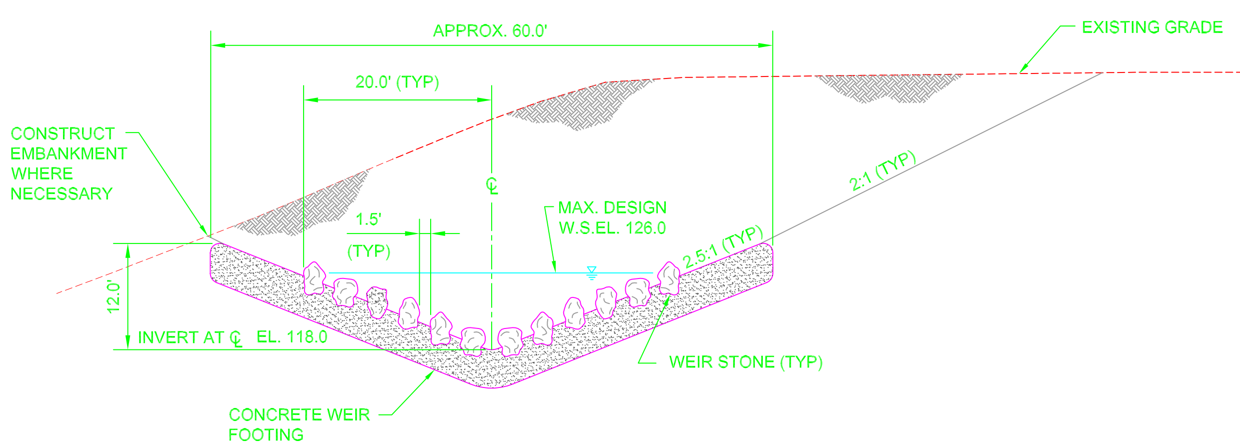
SCALE: 1"=50'



PROFILE

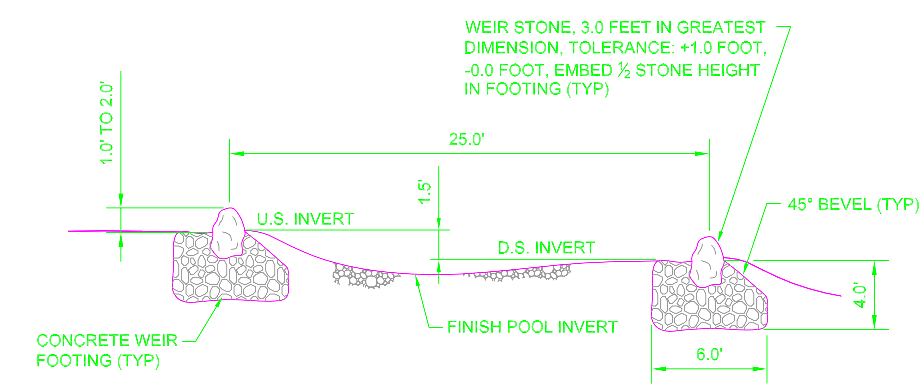
HORIZ. SCALE: 1"=25'

VERT. SCALE: 1"=10'



SECTION A

SCALE: 1"=10'



TYPICAL PROFILE

SCALE: 1"=5'

NOTES:

1. TOPOGRAPHY PROVIDED BY USCOE FROM 1999 SURVEY FOR PRELIMINARY DRAFT HYDROLOGY AND HYDRAULIC DESIGN REPORT ISSUED JUNE 20, 2000.
2. LOCATIONS AND DIMENSIONS OF EXISTING STRUCTURES ARE APPROXIMATE.

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	8/11/02	TWB	FEB	FEB	PRELIMINARY						

DESIGNED BY: T. BULLER
DRAWN BY: T. BULLER
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 8/11/02

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St. Bldg. 100-B Sacramento, CA 95816 Tel 916.341.7760 Fax 916.341.7767

SUBMITTED

APPROVED

DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

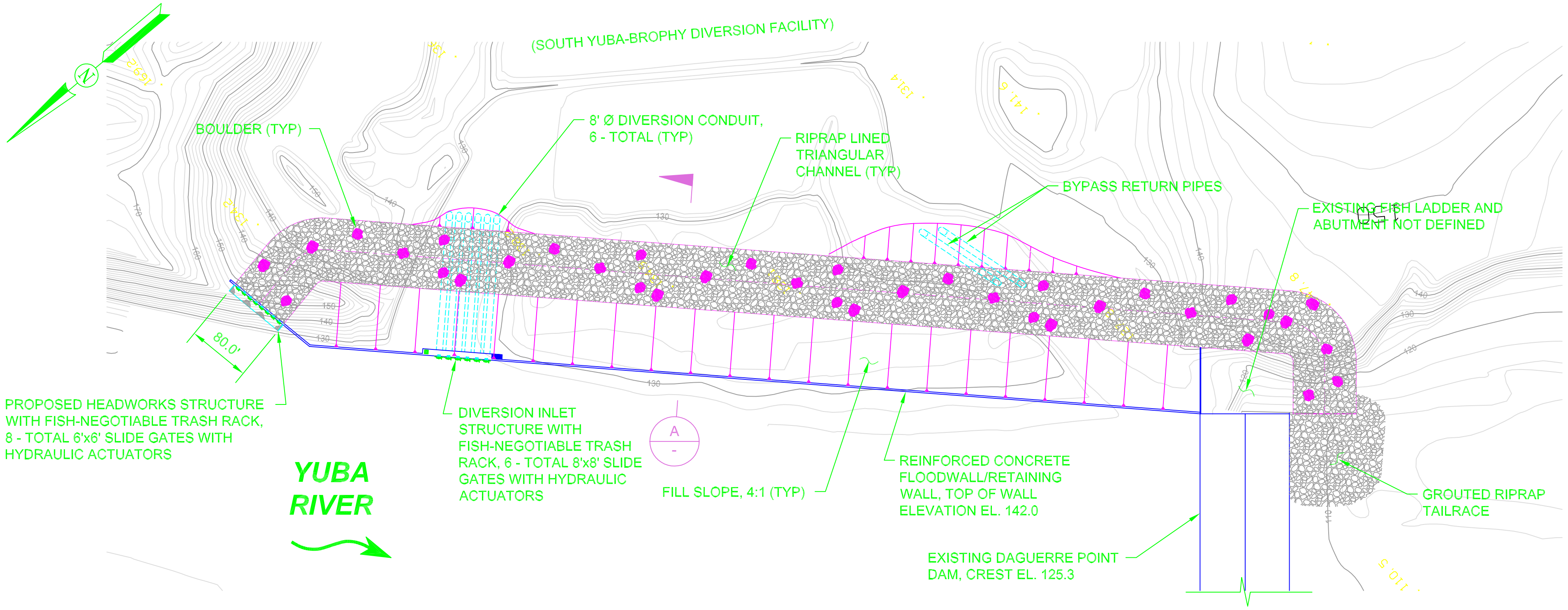
ALTERNATIVE 4A
NATURAL BYPASS CHANNEL - SHORT REACH
PLAN, PROFILES, AND SECTION

SCALE OF ORIGINAL: AS SHOWN

DRAWING NO.: ALT-4A

SHEET: 1

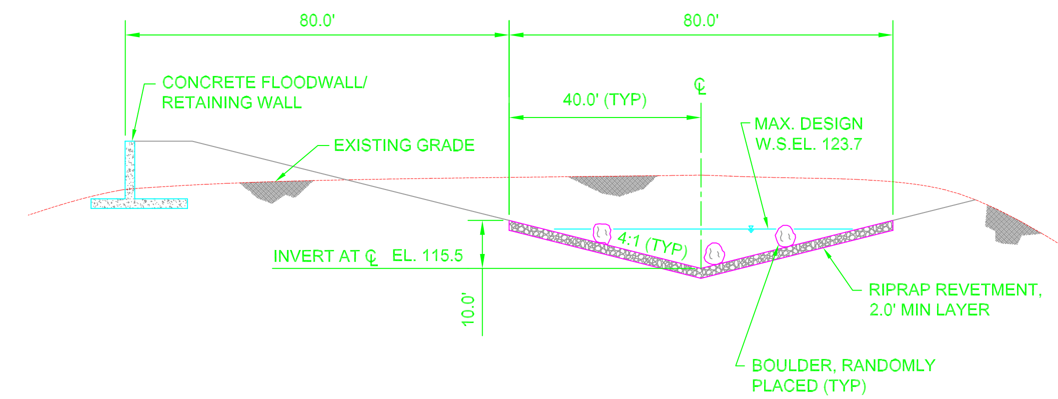
I:\ENGDOCS\PROJECTS\2228\Daguerre Dam\AutoCAD\Alt-4A.dwg



NOTE: GRADING AT EAST SIDE OF PROPOSED CHANNEL AND GRADE CONTROL STRUCTURES NOT SHOWN FOR CLARITY.

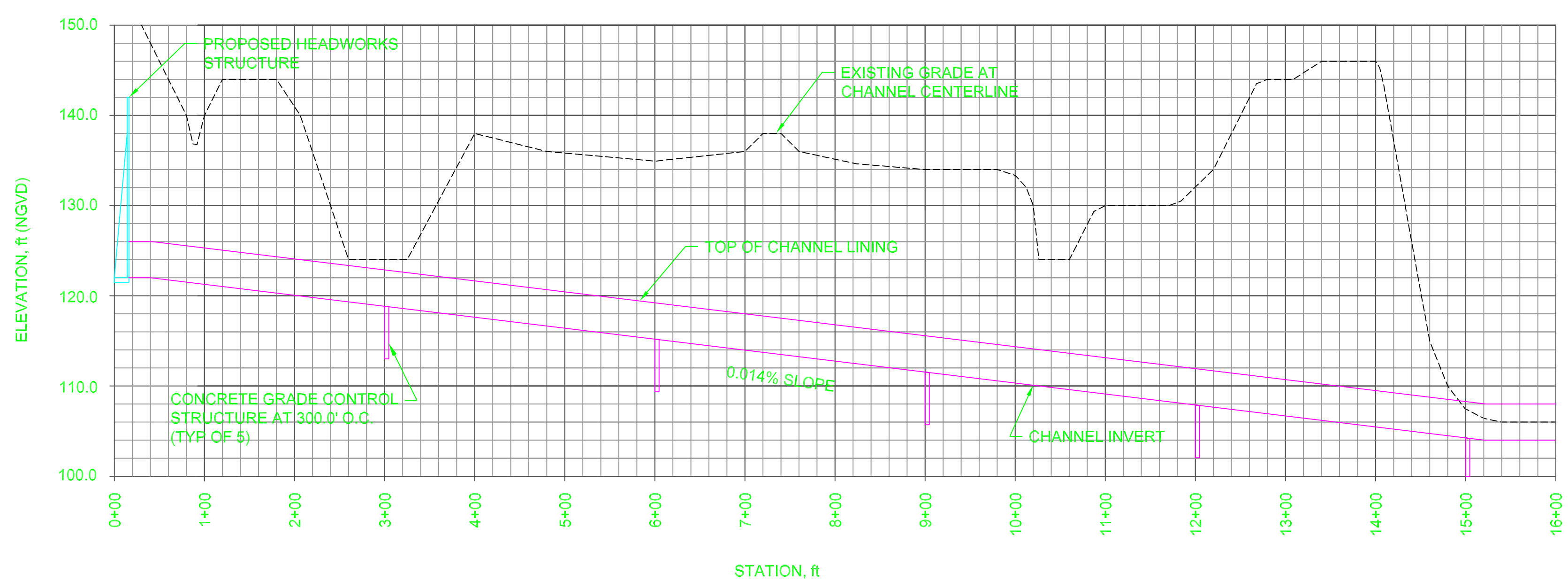
PLAN

SCALE: 1"=100'



SECTION (A)

SCALE: 1"=20'



PROFILE

HORIZ. SCALE: 1"=100'
VERT. SCALE: 1"=10'

NOTES:

1. TOPOGRAPHY PROVIDED BY USCOE FROM 1999 SURVEY FOR PRELIMINARY DRAFT HYDROLOGY AND HYDRAULIC DESIGN REPORT ISSUED JUNE 20, 2000.
2. LOCATIONS AND DIMENSIONS OF EXISTING STRUCTURES ARE APPROXIMATE.

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION	REV	DATE	BY	CHK	APPR	DESCRIPTION
1	8/11/02	TWB	FEB	FEB	PRELIMINARY						

DESIGNED BY: T. BULLER
DRAWN BY: T. BULLER
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 8/11/02

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St, Bldg. 100-B Sacramento, CA 95816 Tel 916.341.7760 Fax 916.341.7767

SUBMITTED

APPROVED

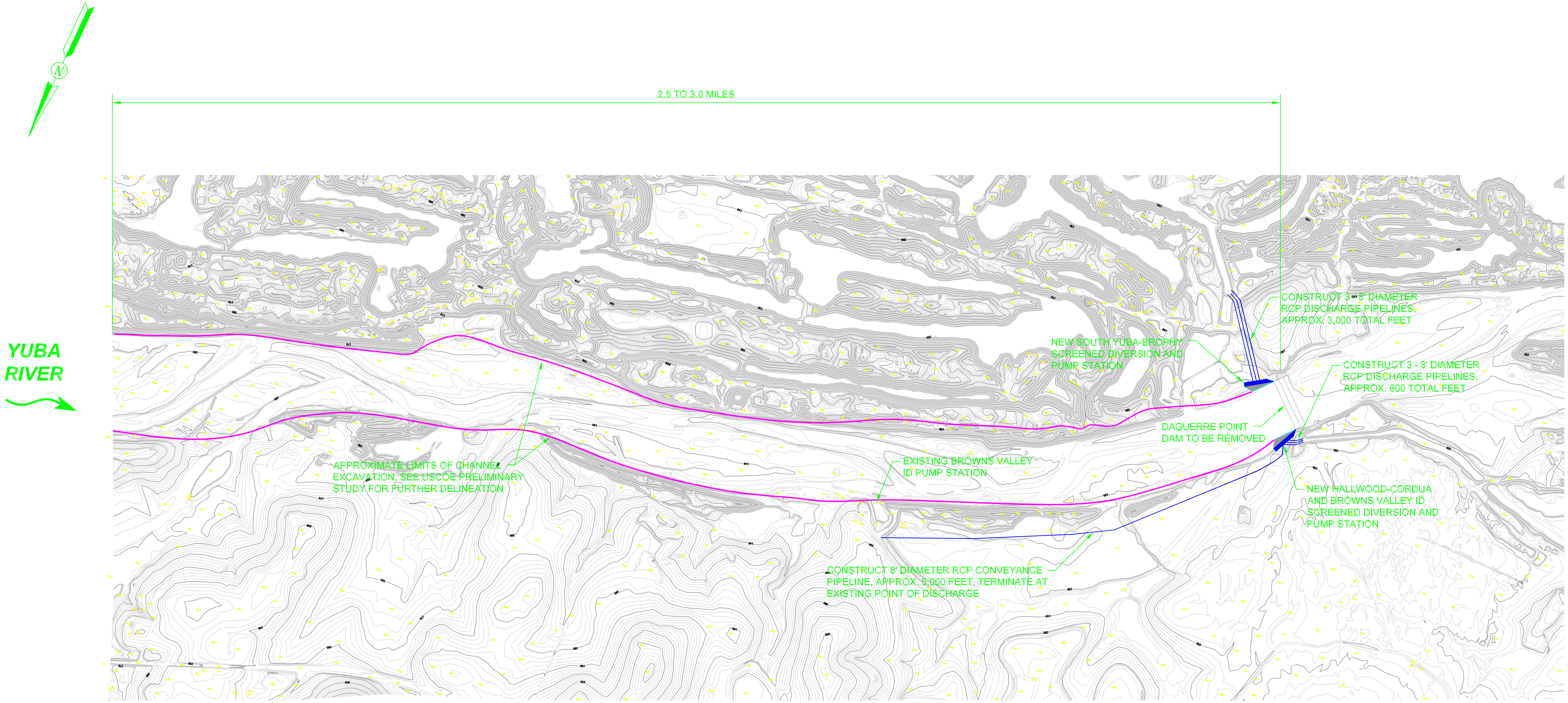
DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE 4B
NATURAL BYPASS CHANNEL - LONG REACH
PLAN, PROFILE, AND SECTION

SCALE OF ORIGINAL: AS SHOWN

DRAWING NO. ALT-4B

SHEET 1



NOTE: EXISTING FISHWAYS, ABUTMENTS, AND DAM STRUCTURES TO BE DEMOLISHED AND REMOVED. SEDIMENT UPSTREAM OF DAGUERRE POINT DAM TO BE EXCAVATED IN ACCORDANCE WITH USCOE PRELIMINARY STUDY.

NOTES:

1. TOPOGRAPHY PROVIDED BY USCOE FROM 1999 SURVEY FOR PRELIMINARY DRAFT HYDROLOGY AND HYDRAULIC DESIGN REPORT ISSUED JUNE 20, 2000.
2. LOCATIONS AND DIMENSIONS OF EXISTING STRUCTURES ARE APPROXIMATE.

PRELIMINARY

HALF-SIZE PRINT

REV	DATE	BY	CHK	APPR	DESCRIPTION
1	8/11/02	TWB	FEB	FEB	PRELIMINARY

REV	DATE	BY	CHK	APPR	DESCRIPTION

DESIGNED BY: T. BULLER
DRAWN BY: T. BULLER
CHECKED BY: F. BORCALLI
IN CHARGE: F. BORCALLI
DATE: 8/11/02

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING
3301 C St. Bldg. 100-B Tel 916.341.7760
Sacramento, CA 95816 Fax 916.341.7767

SUBMITTED

APPROVED

DEPARTMENT OF WATER RESOURCES / U.S. ARMY CORPS OF ENGINEERS
DAGUERRE POINT DAM FISH PASSAGE IMPROVEMENT PROJECT

ALTERNATIVE 5A
REMOVE DAM / NEW SCREENS AND PUMP STATIONS
PLAN

SCALE OF ORIGINAL: 1" = 600'

DRAWING NO.: ALT-5A
SHEET: 1

I:\ENGDOCS\PROJECTS\2-225\Daguerre Dam\AutoCAD\Alt-5A.dwg